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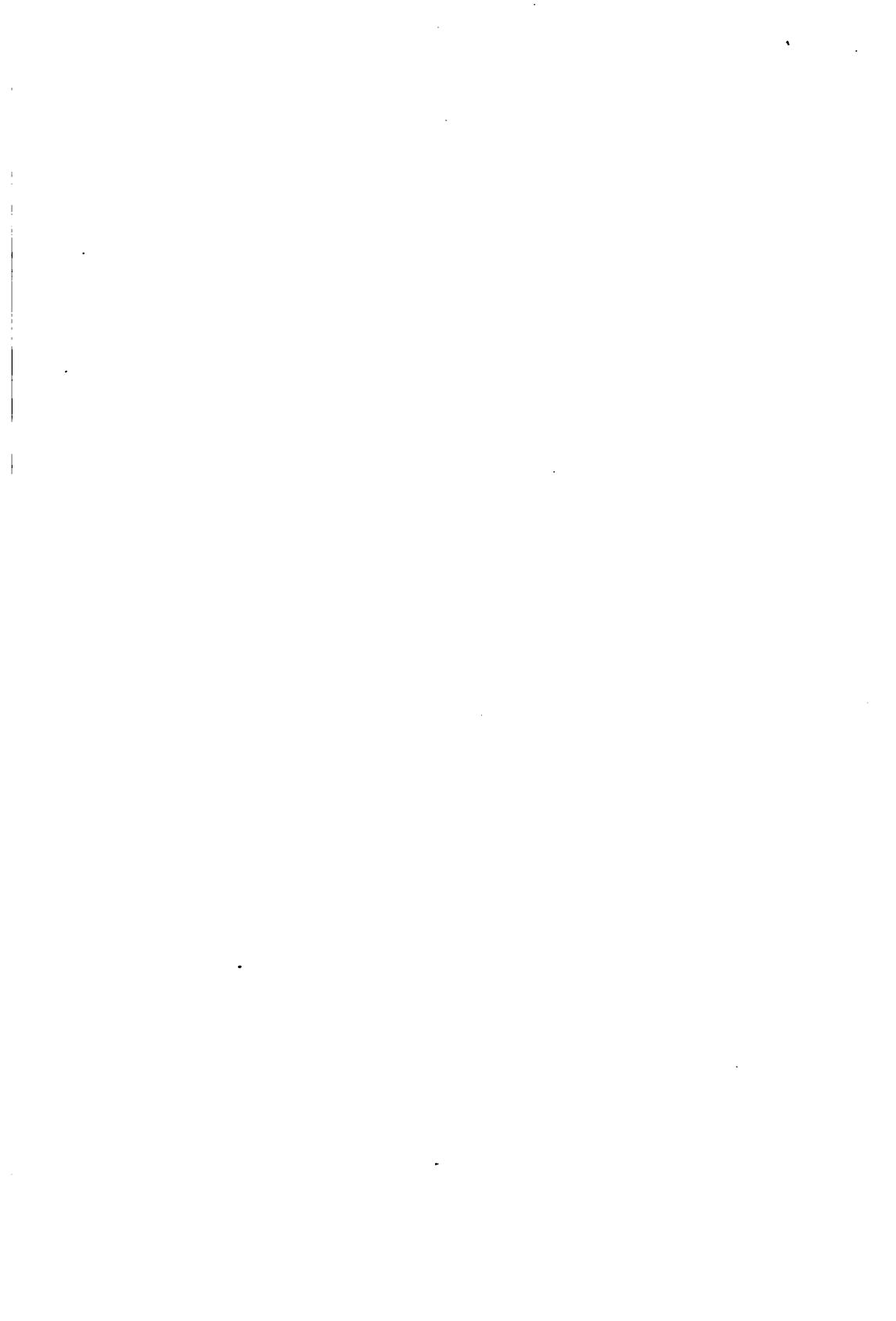
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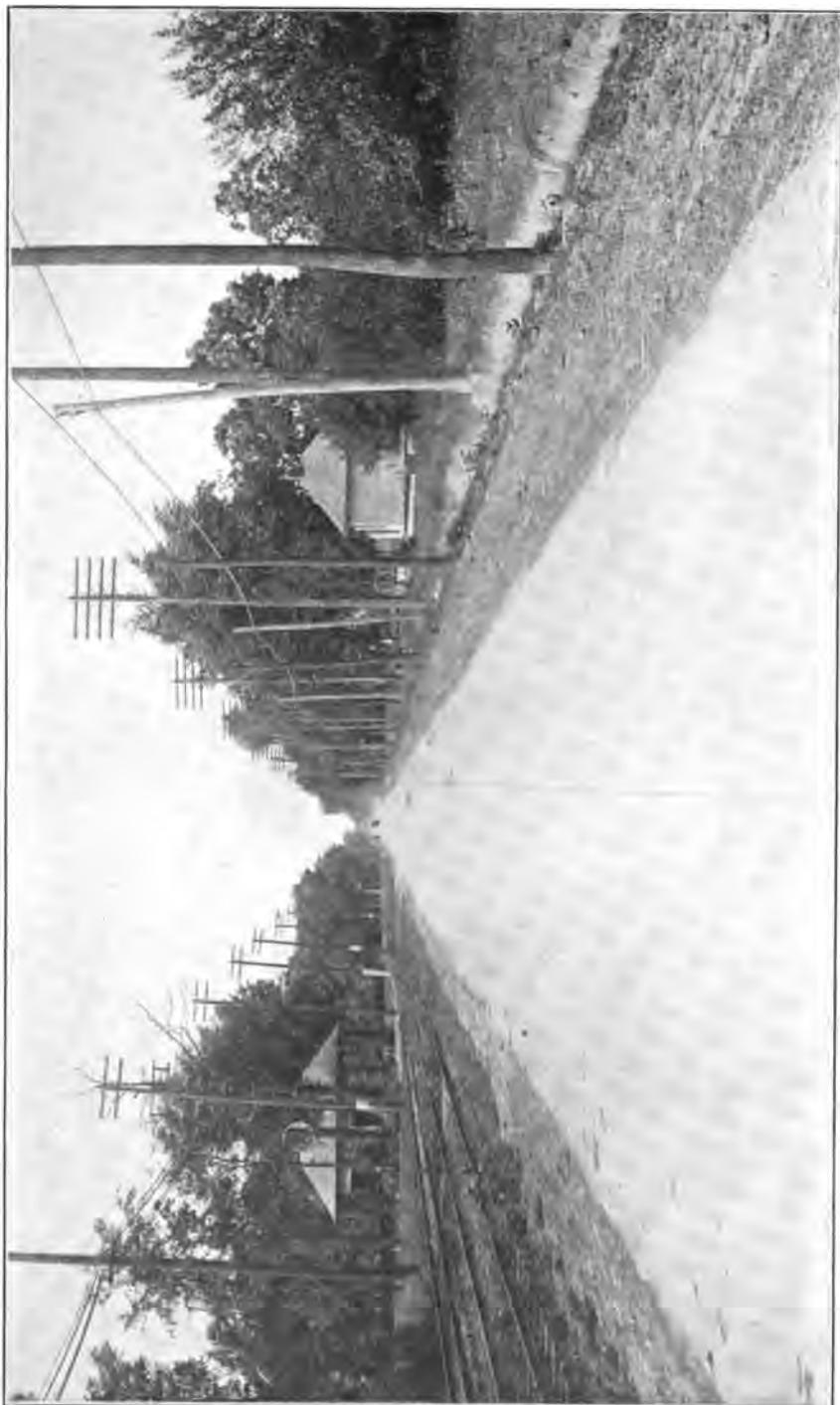
FROM

Michigan State Library









Woodward Avenue Road, Wayne County. Concrete Roadway.

STATE OF MICHIGAN

FOURTH BIENNIAL REPORT

OF THE

STATE HIGHWAY COMMISSIONER

FOR TWO FISCAL YEARS

Ending June 30, 1912.



BY AUTHORITY

LANSING, MICHIGAN
WYNKOOP HALLENBECK CRAWFORD CO., STATE PRINTERS
1912

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Michigan State Library

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STATE HIGHWAY COMMISSIONERS OF MICHIGAN.

Department created by Public Act 146, 1905.

Honorable Horatio S. Earle, 1905-1909. - - - - Detroit.
Honorable Townsend A. Ely, Appointed July 1, 1909 - - - Alma.

MEMBERS AND SALARIES OF THE STATE HIGHWAY DEPARTMENT.

Townsend A. Ely, Commissioner.....	\$2,500.00 per yr.
Frank F. Rogers, C. E., Deputy Commissioner.....	1,800.00 per yr.
Leroy C. Smith, Engineer	1,500.00 per yr.
Wm. W. Cox, Engineer	1,400.00 per yr.
W. Irene McCarthy, Stenographer	800.00 per yr.



LETTER OF TRANSMITTAL.

**Honorable Chase S. Osborn,
Governor:**

In compliance with section 2, Chapter 5, Act 283, Laws of 1909, I have the honor to submit the fourth biennial report of the Michigan State Highway Department.

Very respectfully,
TOWNSEND A. ELY,
State Highway Commissioner.



REPORT.

During the seven years of existence of this Department, the growth of interest in road building has been marked.

- In 1905, 20 miles of State Reward road were built.
- In 1906, 40 miles of State Reward road were built.
- In 1907, 80 miles of State Reward road were built.
- In 1908, 160 miles of State Reward road were built.
- In 1909, 244 miles of State Reward road were built.
- In 1910, 304 miles of State Reward road were built.
- In 1911, 382 miles of State Reward road were built.

The work of the Department has necessarily increased in proportion to the number of miles constructed but, on account of the fact that no greater appropriation is available for the expense of the Department than there was when organized (\$10,000), it has been impossible to give the commissioners building roads the detailed instruction which is for the best interest of the State and the community where the road is being built. Many counties are adopting the county road system, nine during the past year, making forty-four in all. Many of these are bonding for large sums for improving roads and, unless careful supervision is provided to direct construction, much money will be wasted.

It can be noted from Tables No. 7 and 8 of this report, that during the past two years a greatly increased interest has been shown in the State Reward law. During the fiscal year ending June 30, 1911, 427 miles of road were applied for; while during the fiscal year ending with this date, 644 miles have been applied for. At the present time, there is pending 865 miles of road on which there is a state reward asked for of \$559,164.00. For the first time in the history of the Department, the monies appropriated by the legislature were entirely expended during the fiscal year just past. We have available for rewards during the coming year \$235,000.00 which, at the present rate of expenditure, will not take care of all roads completed during the year upon which state reward has been asked.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
	No. application.	Applied for.	Built.				
Bay County. Merritt and Portmouth Twp.—Total last report.			2,000				County.
Merritt Township—Total last report.....	E 806	.....	2,955	1,509	\$1,500 00	.....	County.
Merritt Township.....	E 809	.....	.....	500	500 00	.....	8-8-10
Merritt Township.....	E 810	.....	.....	250	250 00	.....	8-8-10
Merritt Township.....	E 1539	.....	.....	696	696 00	.....	10-4-11
Merritt Township.....	E 1639	6-25-11	1,000	1,000	1,000 00	.....	10-5-11
Merritt Township.....	E 1640	10-13-11	.986	.986	.986 00	.....	10-26-11
Merritt Township.....	A	10-13-11	.967	.....	.....	.....	.....
				5,948	4,951	\$4,951 00	
Monitor and Frankenlust Townships— Total last report.....			500	.401	\$401 00	.....	County.
Hampton (Kawkawlin and Beaver), Monitor and Williams Twp.—Total last report.....			1,750	1,750	\$1,750 00	.....	County.
Pineconning Township—Total last report.....	E 836	.....	3,801	2,301	\$2,301 00	.....	County.
Pineconning Township.....	E 1222	5-10-11	1,000	1,000	1,000 00	.....	10-24-11
Pineconning Township.....			4,801	4,301	\$4,301 00	.....	10-24-11
Portsmouth Township—Total last report.....	E 1208	4-14-11	1,500	1,000	\$1,000 00	.....	County.
Portsmouth Township.....	E 1875	6-15-12	.985	.985	.985 00	.....	10-4-11
Portsmouth Township.....	E 1883	6-18-12	1,231	1,231	1,231 00	.....	County.
Portsmouth Township.....			1,556	1,556	1,556 00	.....	County.
Williams Township—Total last report.....	E .....	.....	5,292	1,985	\$1,985 00	.....	County.
Williams Township.....	E	6-15-12	1,250	1,000	\$1,000 00	.....	County.
			750	.....	.....	.....	County.
Williams and Beaver Twp.—Total last report.....	E 866	.....	2,000	1,000	\$1,000 00	.....	County.
Williams and Beaver Townships.....			1,260	.757	.757 00	483 00	County.
			1,250	1,250	\$1,250 00	8-30-11	County.

STATE HIGHWAY COMMISSIONER.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—*Continued.*

County and township.	Year of application. Number of applica- tions	Date of application.	Length.		Reward paid.	Date of payment.	Built by.	Remarks.
			Applied for.	Built.				
Benton County, Bainbridge Township.....	E 172)	3-1-12	.500				County.	
Benton Township—Total last report.....	E 167	11-10-11	1,008				Township.	
Benton Township.....	E 172	3-1-12	1,250				County.	
Benton Township.....	E 172)	3-1-12	1,000				County.	
Benton Township.....	E 1785	5-7-12	1,000				Township.	
Berrien Township.....	E 1721	3-1-12		5,238				
Berrien Township.....	E 1730	3-1-12		.814			County.	
Buchanan and Bertrand Townships.....	B 951	7-10-12	1,000					
Chickamauga Township—Total last report.....	B 1724	3-1-12	.998			\$498.00	1-5-11	
Chickamauga Township.....	E 1724	3-1-12	.900				Township.	
Hazar—Total last report.....				2,498			County.	
Lake Township.....	E 1725	3-1-12		1,000				
Lincoln Township—Total last report.....	B 106				10,874		7-14-11	
Lincoln Township.....						2,014	\$1,007.00	
New Buffalo Township.....	E 1727	3-1-12			.750			
Niles Township.....	E 1720	3-1-12		.814			County.	
Niles and Bertrand Townships.....	B 1733	3-1-12	1,000				County.	
Oronoko Township.....	E 1732	3-1-12	1,000				County.	
Pipesone Township.....	E 1741	3-13-12	.500				County.	
Royalton Township—Total last report.....					6,570		\$5,699	Township.

STATE HIGHWAY COMMISSIONER.

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arguments to sustain their positions. They tell us that the volume of travel drops off very rapidly as the distance out from a given town increases, which is true, for it is usually twice as great on the first mile as it is on the third and fourth miles out. Then it drops off very markedly as each cross road is passed until a point is reached where the traffic divides with the next nearest town. This is always at or near the point where the inducements offered and the efforts required to reach the two towns about balance, and is never at the midway point unless the roads and market conditions are equal in both directions. Hence, if roads are to be first built where they will serve the most people and the greatest volume of traffic, they must be built almost simultaneously from the various market centers out, favoring to some extent the principal market places, but completing all of the roads near the towns before the distant ends are connected up and through roads thus secured.

An exception to this rule should be noted for the mining regions of the upper peninsula, where the whole demand is for roads that connect the towns. Here the wealth of the country is in the mines, the people live in the towns, agriculture is of secondary importance and the conditions above noted are entirely reversed.

Opposed to this plan are the tourists and people who desire to drive from town to town, and who are very busy in arguing that a mile of good road at this town and a mile at the other town accommodates nobody in particular and gives evidence of an entire lack of system in road building, which is akin to the waste of money. The coming of the automobile has largely added to this latter class of people, who, in fact, constitute a very large part of the people of the other class, for the merchants and farmers who, for business reasons, need the radial roads first, have become automobile owners and now are yearly, weekly or daily visitors of quite distant as well as the nearby towns. This has brought to their notice and then to our attention the wretched condition of many outlying roads, which for economic reasons have heretofore been neglected. Such people are loud in their demands that the through roads be improved and are anxious and willing to pay their proportion of the cost of such improvement. All of these people, who in the very business by which they earn money to pay for their recreation adhere rigidly to the principles of economy and will not spend a dollar unless it shall be returned to them with profit, are ever ready to spend money for good roads with a free hand and are not prone to count the cost nor the returns on the investment. In no other way can the insistent demand for through roads be explained. Nevertheless, this demand is plain and urgent and the road builder who does not heed it is likely to be run over by the wheels of progress.

There is yet another reason why Michigan should give some heed to the demands of the motor car. It manufactures 60% of all the cars made in the United States. In 1910, the value of automobiles produced in Michigan was more than a million dollars greater than that of twelve of her staple and leading farm crops. Can such an industry be ignored? Though at present the automobile is largely a pleasure vehicle, the next ten years will see its economic possibilities developed beyond the dreams of the most sanguine, but good roads must be the *rule* and not the *exception* before that time shall arrive.



Showing completed bituminous bound "mine rock" macadam road constructed between Hancock and Calumet, Houghton County. The upper view shows portable tank for heating bitumen used on this road. Bitumen was spread upon top course of rock by hand with spreading buckets shown. This road was constructed with rock fifteen feet wide on a twenty-four to twenty-six foot turnpike.

Some of the benefits that will then be derived may be summed up as follows:

(1) The number of days in the year that a team can use the road will be increased.

(2) Crops yielding a greater tonnage and a greater profit per acre can be grown, e. g. wheat and sugar beets.

(3) Light loads can be hauled at greater speed.

(4) Any rise in the market can be taken advantage of.

(5) More markets can be reached by each farmer.

(6) Car shortage in the fall can be reduced.

(7) Money shortage will be less frequent as the marketing season is extended.

(8) Rural mail and parcels post will be more rapidly extended, because of lessened expense.

(9) Motor cars and trucks will largely take the place of horse drawn vehicles on the highways. Market gardeners around Detroit are already beginning to use them and are saving three-fourths of the time formerly spent on the road.

That some progress in road building has already been made in this state will be shown by the map in the back of this report, the photographs of newly built roads and the several tables giving in detail the work done by counties and townships.

FOURTH BIENNIAL REPORT.

TABLE NO. 2—Showing Amount Appropriated for the Use of the Department for Paying State Reward Since Organization to June 30, 1911.

For fiscal year 1906.....	\$30,000 00
" " " 1907.....	60,000 00
" " " 1908.....	110,000 00
" " " 1909.....	160,000 00
" " " 1910.....	150,000 00
" " " 1911.....	150,000 00
" " " 1912.....	245,000 00
" " " 1913.....	245,000 00
 Total 8 years.....	 \$1,150,000 00

Ten thousand dollars of each of the above named amounts constitutes a fund for the current expenses of the Department.

TABLE NO. 3.

CURRENT EXPENSES.

Fiscal Year Ending June 30, 1911.

Balance from 1910 fiscal year.....	\$48 96
Appropriation for 1911 fiscal year.....	10,000 00
Salaries:	
T. A. Ely.....	\$2,500 00
F. F. Rogers.....	1,800 00
F. G. Randall.....	1,200 00
L. C. Smith.....	1,200 00
W. W. Cox.....	108 79
W. I. McCarthy.....	788 20
W. B. Clark.....	175 76
J. J. Cox.....	80 00
Minnie Randall.....	12 00
Edith Perley.....	78 00
	\$7,942 75
Traveling expenses:	
T. A. Ely.....	17 23
F. F. Rogers.....	135 69
L. C. Smith.....	8 81
J. J. Cox.....	77 83
Postage.....	600 00
Printing, binding and engraving.....	881 54
Stationery, drawing paper and engineering supplies.....	210 06
Express and cartage.....	5 21
Livery.....	2 50
Telephone and telegraph.....	36 27
Typewriter and mimeograph supplies.....	12 09
Photos.....	6 25
Sundries.....	10 70
	\$9,946 93
Balance carried forward to 1912 fiscal year.....	
	\$10,048 96
	9,946 93
	\$102 03

TABLE NO. 4.

CURRENT EXPENSES.

Fiscal Year Ending June 30, 1912.

Balance from 1911 fiscal year.....	\$102 03
Appropriation for 1912 fiscal year.....	10,000 00
Salaries:	
T. A. Ely.....	\$2,500 00
F. F. Rogers.....	1,800 00
L. C. Smith.....	1,262 64
W. W. Cox.....	1,216 50
W. I. McCarthy.....	800 00
D. G. Brown.....	39 64
Wm. Baumgras.....	201 10
F. G. Randall.....	847 25
Grace Spaulding.....	64 56
I. B. Smith.....	12 00
Claude Atchison.....	1 50
	<hr/>
	\$8,745 19
Traveling expenses:	
T. A. Ely.....	85 70
F. F. Rogers.....	285 54
L. C. Smith.....	24 75
W. W. Cox.....	271 68
Wm. Baumgras.....	58 84
E. W. Muenscher.....	49 99
Postage.....	300 00
Printing, binding and engraving.....	118 33
Stationery, drawing paper and engineering supplies.....	43 80
Telephone and telegraph.....	15 71
Express.....	6 44
Sundries.....	62 23
	<hr/>
	\$10,068 20
	<hr/>
Balance carried forward to 1913 fiscal year.....	\$33 83
	<hr/>
	\$10,102 03
	<hr/>
	10,068 20

TABLE NO. 5.

MOTOR VEHICLE FUND.

Expenditures for Fiscal Year Ending June 30, 1911.

Traveling expenses:	
T. A. Ely.....	\$337 21
F. F. Rogers.....	669 74
L. C. Smith.....	574 97
W. W. Cox.....	46 58
W. B. Clark.....	9 59
Col. E. W. Muenscher.....	37 36
E. W. Redman.....	24 30
Printing and binding.....	33 09
Express.....	70
Stationery.....	19 04
Lantern slides.....	20 00
Telephone and telegraph.....	6 95
Sundries.....	20 75
	<hr/>
	\$1,800 28

FOURTH BIENNIAL REPORT.

TABLE NO. 6.

MOTOR VEHICLE FUND.

Expenditures for Fiscal Year Ending June 30, 1912.

Traveling expenses:				
T. A. Ely.....			\$113 29	
F. F. Rogers.....			590 42	
L. C. Smith.....			497 45	
W. W. Cox.....			389 16	
E. W. Muenscher.....			94 95	
K. I. Sawyer.....			17 28	
Postage.....			200 00	
Printing, binding and engraving.....			171 44	
Stationery, drawing paper and engineering supplies.....			144 34	
Typewriting supplies.....			12 92	
Telephone and telegraph.....			34 92	
Express and cartage.....			15 85	
Sundries.....			7 30	
				\$2,289 32

TABLE NO. 7.—Showing number miles of State reward road applied for, number miles built, state reward applied for and state reward paid, by classes, for the fiscal year ending June 30th, 1911.

Class.	Miles applied for.	Miles built.	Reward applied for.	Reward paid.
A.....	1,696		\$424 00	
B.....	323,010	216,200	161,505 00	\$108,100 00
C.....	12,876	6,540	9,652 00	4,905 00
D.....		2,375		1,781 00
E.....	89,809	79,090	89,809 00	79,090 00
Total.....	427,191	304,205	\$261,190 00	\$193,876 00

TABLE NO. 8.—Showing number miles of State reward road applied for, number miles built, number miles cancelled or rejected, state reward applied for, state reward paid and state reward cancelled or rejected, by class, for the fiscal year ending June 30th, 1912.

Class.	Miles applied for.	Miles built.	Miles cancelled or rejected.	Reward applied for.	Reward paid.	Reward cancelled or rejected.
A.....	28,336	14,544	2,940	\$1,084 00	\$3,636 00	
B.....	424,370	236,842	.905	212,185 00	118,421 00	\$1,470 00
C.....	25,656	12,500		19,242 00	9,375 00	604 00
D.....	3,066	1,912		2,300 00	1,434 00	
E.....	140,309	100,125	2,185	140,309 00	100,125 00	2,185 00
F.....	22,383	16,680		22,383 00	16,680 00	
Total.....	644,120	382,603	5,930	\$403,503 00	\$249,671 00	\$4,259 00

TABLE NO. 9.—Showing total number miles applied for, total number of miles built, total number of miles cancelled or rejected, total number miles pending, total reward applied for, total reward paid, total reward cancelled or rejected and total reward pending, by classes at close of day, June 30, 1912.

Class.	Miles applied for.	Miles built.	Miles cancelled or rejected.	Miles pending.	Reward applied for.	Reward paid.	Reward cancelled or rejected.	Reward pending.
A.....	37,573	18,288	1,056	18,229	\$9,393 25	\$4,572 00	\$264 00	\$4,557 25
B.....	1,526,287	750,218	28,886	547,183	663,143 50	375,109 00	14,443 00	273,591 50
C.....	67,632	23,671	5,804	38,157	50,718 25	17,753 00	4,354 00	28,611 25
D.....	11,869	10,133	.....	1,736	8,902 00	7,600 00	.....	1,302 00
E.....	764,597	413,288	15,912	245,399	674,597 00	413,288 00	15,912 00	245,399 00
F.....	22,382	16,680	.....	5,703	22,383 00	16,680 00	.....	5,703 00
Total..	2,140,340	1,232,276	51,658	865,407	\$1,429,137 00	\$335,000 00	\$34,973 00	\$559,164 00

NOTE.—Difference in reward applied for and miles applied for caused by changes in class of certain applications since the third biennial report, June 30, 1910.

Miles applied for class A + .240, class B - 13.026, class C + 4.364, class C - 1.268, class E + 9.690.

Reward applied for class A + \$60, class B - \$6,513, class C + \$3,273, class D - \$951, class E + \$9,690.

Net total difference + \$5,559.00.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—*Showing the number of miles of state reward road applied for, number of miles built, and the total reward paid, etc., to each township from the date of organization of the Department to June 30th, 1912.*

County and township.	Class.	Number of roads applied for.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
Alger County:								
Au Train Township—Total last report.....	E	690		5.708	\$1,157.00	5-19-11		
Au Train Township.....	E	697		500	500	County.		
Au Train Township.....	E	714		3,125	3,125.00	7-14-11		
Au Train Township.....	E	715		3,360	3,360.00	5-19-11		
Au Train Township.....	E	403		268	268.00	5-19-11		
Au Train Township.....	E			167	167.00	7-18-11		
Munising Township—Total last report.....				5.708	5,708			
				2,843	2,843			
					\$2,943.00			
Allegan County:								
Filmore Township.....	E	1314	6-14-11	1,000	\$1,000.00	1-8-12	Township.	
Filmore Township.....	E	1931	6-29-12	1,000	1,000	.....	Township.	
				2,000	1,000	\$1,000.00	.....
Olesgo Township—Total last report.....				1,000	1,000	.....	Township.....	Cancelled.
Wayland Township—Total last report.....	C	940	7-7-10	1,250	1,000	\$750.00	Township.	
Wayland Township.....	B	1048	8-29-10	.503	.503	377.00	Township.	
Wayland Township.....	C	1890	6-17-12	.996	.996	250.00	Township.	
				1,046	1,046	.....	Township.	
				3,795	2,003	\$1,377.00	.....
Alpena County:								
Alpena Township—Total last report.....				1,458	1,458	.....	Township..	Cancelled.
Antrim County:								
Banks Township.....	B	980	7-29-10	1,230	1,230	.....	Township.	
Central Lake Township.....	B	1794	6-7-12	1,000	1,000	.....	Township.	
Chestonia Township—Total last report.....	B	857	.....	3,099	1,320	\$660.00	Township.	
Chestonia Township.....	B	1316	6-14-11	2,000	1,779	889.00	Township.	
Chestonia Township.....	B	1799	5-11-12	1,460	1,856	928.00	Township.	

STATE HIGHWAY COMMISSIONER.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Number of applicants for.	Date of application.	Length.	Reward paid.	Built by.	Remarks.
			Applied for.	Built.			
Star Township—Total last report.	B	554	.....	2,000	1,000	\$500 00	Township.
Star Township.....	B	1033	8-24-10	.983	1,000	500 00	8-16-10 Township.
Star Township.....	B	1034	8-24-10	.739	500	250 00	10-3-11 Township.
Star Township.....	B	1085	9-22-11	.500	739	368 00	10-3-11 Township.
Star Township.....	B	1096	9-22-11	.222	.....	.....	Township.
Star Township.....	B	1097	9-22-11	.058	.....	.....	Township.
Arenac County:							
Deep River Township.....	B	1661	10-27-11	1,010	.....	.....	Township.
Burke County:							
Burke and L'Anse Towns—Total last report.		.....	.....	1,000	.....	.....	County.
Barry County:							
Baltimore Township—Total last report.....		.....	.....	2,000	2,000	\$1,000 00	.....
Carlton Township—Total last report.....	B	588	.....	5,200	3,022	\$1,511 00	.....
Carlton Township.....	B	863	.....	.....	1,000	500 00	11-22-11 Township.
Carlton Township.....	B	1521	8-19-11	1,098	1,098	1,178	Township.
Carlton Township.....	B	.....	.....	6,298	6,298	589 00	9-16-10 Township.
Carlton Township.....	B	.....	.....	.....	.....	589 00	11-22-11 Township.
Castleton Township—Total last report.....	B	1437	6-28-11	1,000	1,000	.....	.....
Castleton Township.....	B	.....	.....	2,000	.....	.....	Township.
Hastings Township—Total last report.....	B	.....	.....	2,008	2,008	\$1,004 00	.....
Johnstown Township.....	B	1671	11-3-11	1,320	.....	.....	Township.
Irving Township.....	B	1777	4-4-12	1,250	.....	.....	Township.
Irving Township.....	B	1919	6-29-12	1,010	.....	.....	Township.
Rutland Township—Total last report.....	B	1250	5-10-11	2,260	2,260	.....	.....
Rutland Township.....	B	1250	5-10-11	4,797	3,356	\$1,678 00	Township.
Rutland Township.....	B	1250	5-10-11	1,280	1,280	Township.

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Rutland Township.....	B	1230	5-10-11	1,000				Township.
Thornapple Township.....	B	1094	10-10-10	7,077	3,356	\$1,678 00		
Thornapple Township.....	B	1452	8-4-11	1,000	1,000 ⁽¹⁾	\$500 00	1-5-11	Township.
Thornapple Township.....	B			1,080	1,080	540 00	1-3-12	Township.
Woodland Township.....	B	1342	6-28-11	1,000		\$1,040 00		
Bay County:								
Baugor Township—Total last report.....	E	804		1,750	1,250	\$1,250 00		
Baugor Township.....	E	1359	7-7-11	.992	.500	500 00	1-6-11	County.
Baugor Township.....	E	1830	8-25-11	.173	.173	173 00	10-6-11	County.
Baugor Township.....	E	1873	6-15-12	.694				County.
Baugor Township.....	E			3,609	1,923	\$1,923 00		County.
Baugor and Monroe Townships—Total last report.....			3,550	2,800	\$2,800 00			County.
Beaver Township—Total last report.....	E	1209	4-14-11	2,066	2,000	\$2,000 00		
Beaver Township.....	E		.988					County.
Frankenlust Township—Total last report.....			3,064	2,000	\$2,000 00			County.
Fraser Township—Total last report.....	E	887		2,233	2,233	\$2,233 00		
Fraser Township.....	E	1301	6-6-11	1,000				County.
Hampton Township—Total last report.....			4,555	3,555	\$3,555 00			County.
Hampton Township.....	E	889		1,287	.500	\$500 00		
Hampton Township.....	E	1012	8-15-10	1,380	1,380	757 00	8-8-10	County.
Hampton Township.....	E			2,917	2,917	1,330 00	3-20-11	County.
Kawkaulin Township—Total last report.....	E	573		4,496	2,042	\$2,042 00		
Kawkaulin Township.....	E	813			1,102	1,102 00	2-24-11	County.
Kawkaulin Township.....	E	821			.600	500 00	1-5-11	County.
Kawkaulin Township.....	E	1207			1,362	832 00	9-16-10	County.
Kawkaulin Township.....	E	1528	4-14-11	2,509	1,600	1,600 00	11-24-11	County.
Kawkaulin Township.....	F	1556	8-25-11	.161				County.
Kawkaulin Township.....	C		9-6-11	.998				County.
Kawkaulin Township.....	E	1557	9-6-11	1,076	1,076	1,076 00	2-22-12	County.
Merritt Township.....			9,240	7,072	\$7,072 00			
Merritt Township.....	E	1302	6-6-11	.312	.312	\$312 00	9-20-11	County.

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TABLE NO. 10.—Continued.

County and township.	Date of application. Year and month of application.	Length.		Reward paid.	Date of payment.	Built by.	Remarks.
		Applied for.	Built.				
Clare County—Con-							
Grant Township—Total last report.	B	.....	3,003	2,000	\$1,000 00	.....	Township.
Grant Township.	B	881	.....	.500	250 00	.....	Township.
Grant Township.	B	880	.....	.500	250 00	.....	Township.
Grant Township.	B	1897	6-8-12	.804	500 00	.....	Township.
Grant Township.	B	1898	6-8-12	.804	500 00	.....	Township.
Greenwood Township—Total last report.	B	.....	4,411	3,003	\$1,501 00	.....	Township.
Greenwood Township.	B	885	8-26-11	1,040	1,040	.....	Township.
Greenwood Township.	A	1896	.....	1,494	1,000	.....	Township.
Hatten Township—Total last report.	B	.....	2,534	2,040	\$770 00	.....	Township.
Hatten Township.	B	683	.....	1,004	1,004	.....	Township.
Hatten Township.	B	1896	7-1-11	1,210	.500	.....	Township.
Hatten Township.	B	1867	10-31-11	1,002	.500	.....	Township.
Hatten Township.	B	1861	6-15-12	1,254	.....	.....	Township.
Lovells Township—Total last report.	C	.....	4,530	2,004	\$1,002 00	.....	Township.
Sheridan Township—Total last report.	C	.....	2,008	.....	.....	.....	Township.
Crawford County:							
Frederic Township—Total last report.	C	1564	9-7-11	2,070	2,034	\$1,017 00	.....
Frederic Township.	C	1565	9-7-11	.448	.436	327 00	.....
Frederic Township.	C	1566	9-7-11	.549	.549	412 00	.....
Frederic Township.	C	1566	9-7-11	.814	.....	.....	.....
Lovells Township.	C	1674	11-11-11	1,780	3,881	\$1,756 00	.....
Maple Forest Township.	C	963	7-18-10	1,004	1,004	\$753 00	9-22-10 Township.
Maple Forest Township.	C	1090	10-14-10	1,000	.234	175 00	10-19-10 Township.
South Branch Township—Total last report.	B	1004	9-11-10	2,004	1,238	\$928 00	7-14-11 Township.
South Branch Township.	B	1921	6-28-12	2,818	2,818	\$1,409 00
				1,004	1,004

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South Branch Township.....		B	1920	6-28-12	1,068	Township.
					4,880	2,818	\$1,409 00		
Delta County:	Baldwin Township—Total last report.				2,449				County.
Baldwin and Brampton Townships—Total last report.....					4,311				County.
Bark River Township—Total last report.....					4,280	4,000	\$4,000 00		County and township.
Bark River Township.....	E	675	7-26-10	2,868	.279	279	279 00		Township.
Bark River Township.....	E	978	7-26-10	2,868	2,182	2,182	2,182 00		Township.
Bark River Township.....	E	1225	7-26-11	2,868	2,988	2,988	2,988 00		Township.
Bark River Township.....	E	1683	12-1-11	.250	.....	.....	.....		Township.
Brampton Township—Total last report.....					10,386	9,449	\$9,449 00		County.
Ecanaba Township—Total last report.....					2,000	.....	.....		County.
Ecanaba Township—Total last report.....	E	132	7-12-28	3,152	32,152	32,152	32,152 00		County and township.
Ecanaba Township.....	E	676	7-12-28	1,433	1,453	1,453	1,453 00		County.
Ecanaba Township.....	E	865	9-6-11	1,012	1,12	1,12	1,12 00		Township.
Ecanaba Township.....	E	1561	9-6-11	2,150	2,150	2,150	2,150 00		Township.
Fairbanks Township.....	E	954	7-18-10	.750	.....	.....	.....		County.
Ford River Township—Total last report.....					3,060	3,060	\$3,060 00		County.
Ford River Township.....	E	1088	9-30-10	1,000	1,000	1,000	1,000 00		Township.
Maple Ridge Township—Total last report.....	E	130	.....	4,060	4,060	4,060	\$4,060 00		County.
Masonville Township—Total last report.....					12,310	.750	.....		County.
Masonville Township.....	E	1471	8-17-11	2,000	2,000	2,000	\$2,000 00		Township.
Nahma Township.....	E	133	.....	8,002	2,500	2,500	\$2,500 00		County.
Wells Township—Total last report.....					476	.....	.....		County.
Wells Township.....	E	478	.....	.....	500	500	500 00		County.
Wells Township.....	E	595	.....	.....	1,477	1,477	1,477 00		County.
Wells Township.....	E	696	.....	.....	1,971	1,971	1,971 00		County.
Wells Township.....	E	1031	8-15-10	1,000	448	448	448 00		County.
Wells Township.....	E	1031	8-26-10	.697		County.

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Eaton Township—Total last report.....	B	1600	8-16-11	3,000	3,000	\$1,500.00	6-24-12	Township.
Eaton Township.....	B	1501	8-16-11	.500	.500	250.00	6-24-12	Township.
Eaton Township.....	B	1502	8-16-11	.500	.500	322.00	6-24-12	Township.
Eaton Township.....	B	1503	8-16-11	.500	.500	303.00	6-24-12	Township.
Eaton Township.....	B					553.00	6-24-12	Township.
Eaton Rapids Township—Total last report.....	B	907			5,000	4,000	\$2,000.00	
Eaton Rapids Township.....	B	908			5,386	3,599	\$1,800.00	
Eaton Rapids Township.....	B	909				1,644	250.00	1-5-11
Eaton Rapids Township.....	B	1298	6-1-11	1,106	1,106	1,006	322.00	Township.
Eaton Rapids Township.....	B	1871	6-15-12	.500			303.00	Township.
Eaton Rapids Township.....	B				6,485		553.00	Township.
Hamlin Township—Total last report.....	B	970	7-20-10	5,000	4,000	\$2,000.00	10-24-11	Township.
Hamlin Township.....	B	971	7-20-10	.500	.500	246.00	1-5-11	Township.
Hamlin Township.....	B	1000	8-9-10	.492	.492	246.00	10-24-11	Township.
Hamlin Township.....	B	1001	8-9-10	.500	.500	250.00	1-5-11	Township.
Hamlin Township.....	B	1474	7-28-11	.500	.500	250.00	10-24-11	Township.
Hamlin Township.....	B	1475	7-29-11	.500	.500	250.00	12-6-11	Township.
Oneida Township—Total last report.....	B	1604	8-16-11		7,992	6,992	\$3,496.00	
Oneida Township.....	B	1505	8-16-11	1,250				Township.
Oneida Township.....	B			1,000				Township.
Walton Township—Total last report.....	B	1326	5-19-11	1,000	1,000	*\$500.00	1-3-12	Township.
Walton Township.....	B	1801	5-11-12	1,306				Township.
Windsor Township—Total last report.....	B	1825	5-27-12	2,306	1,000	\$500.00		Township.
Windsor Township.....	B	1826	5-27-12	1,000				Township.
Emmet County—Carp Lake Township—Total last report.....								County.
Maple River Township—Total last report.....								County.
Resort Township—Total last report.....	E	814						County.
Sprucefield Township—Total last report.....	B	953	7-14-10	2,840	1,950	\$1,950.00	9-22-10	County.
Sprucefield Township—Total last report.....	B			2,840	1,950	\$1,950.00		County.

TABLE NO. 10.—*Continued.*

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Eckford Township—Total last report.....	E	604	Extension.....	1.926	1.000	\$1,000.00	10-14-10	Township
Eckford Township.....	E	1305	.....6-7-11	2.000	935	935.00	11-7-11	Township
Eckford Township.....	E				1,790	1,790.00		
Emmett Township—Total last report.....	B	694	.....9-14-10	3.935	3.734	\$3,734.00		
Emmett Township.....	B	1073	.....7-25-11	4.814	2.608	\$1,288.00	9-16-10	Township
Emmett Township.....	B	1426	.....1,600	1,200	600	600.00	7-14-11	Township
Emmett Township.....	B		1,600	800	800	800.00		
Leroy Township—Total last report.....	B	695	.....3-5-12	7.414	5.408	\$2,688.00		
Leroy Township.....	B	1734	.....2,000	4.018	2,000	\$1,000.00	8-30-11	Township
Leroy Township.....	B		1,000	500	500	500.00		
Marengo Township—Total last report.....	E	717	.....6-06-4	1.75	3.000	\$1,500.00		
Marengo Township.....	E	1440	.....8-3-11	1.75	1.75	\$175.00	7-7-10	Township
Marengo Township.....	B	1831	.....8-25-11	506	1,042	1,042.00		
Marshall Township—Total last report.....	B	1088	.....10-12-10	1.723	1.75	\$175.00		
Marshall Township.....	B	1923	.....6-28-12	1,000	4,416	4,416.00		
Newton Township—Total last report.....	B	965	.....7-18-10	6,426	1,000	\$500.00		
Newton Township.....	B	986	.....7-18-10	3,004	2,004	\$1,002.00		
Pensfield Township—Total last report.....	B	709	.....1,504	5,022	2,004	\$1,002.00		
Pensfield Township.....	B	897	.....614					
Tekonka Township—Total last report.....	E	667	.....3-20-12	3.000	2,000	\$1,000.00		
Tekonka Township.....	E	17461,128	1,128	1,128	\$1,128.00	10-31-11	Township
Tekonka Township.....	E	1763811					
				2,950	1,128	\$1,128.00		

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TABLE NO. 10.—Continued.

County and township.	Class.	Number of applicants for compensation.	Date of application.	Length. Applied for.	Reward paid.	Date of payment.	Built by.	Remarks.
Tennessee County - Con.								
Vienna Township.....	E	1894	6-21-12	2 197			County.	
Vienna and Genesee Townships.....	E	1787	4-30-12	4 290			County.	
Genesee County:								
Hessner & Ironwood Townships.....	E	1898	12-11-11	3 060	2,413	\$2,413 00	2-20-12	County.
Grand Traverse County:								
Acme Township - Total last report.....	B	1178	3-18-11	1,050	1,050	\$525 00	9-7-11	Township.
Acme Township.....	B	1406	7-19-11	1,70	1,70	85 00	11-20-11	County.
Acme Township.....	B	1774	3-16-12	1,006	1,006	503 00	11-20-11	Township.
Blair Township - Total last report.....	B	673		2,226	2,226	\$1,113 00		County and township.
Blair Township.....	B	1545	8-28-11	748				Township.
Blair Township.....	B	1774	3-16-12	2,002				Township.
Blair Township.....	B	-		4,771	2,021	\$1,010 00		Township.
East Bay Township - Total last report.....	B	1177	3-18-11	1,019	981	\$490 00	9-7-11	County.
East Bay Township.....	B	1712	2-5-12	1,591	1,516	758 00	9-7-11	County.
East Bay Township.....	B	-		1,080				County.
Fife Lake Township.....	B	1171	3-2-11	495				
Fife Lake Township.....	A	1495	8-16-11	.920				
Fife Lake Township.....	A	-		1,415	.920			
Garfield Township - Total last report.....	B	-		1,952				
Garfield Township.....	B	730						County.
Garfield Township.....	B	850						County.
Garfield Township.....	B	1179						County.
Garfield Township.....	B	1745						County.
Garfield Township - Total last report.....	B	-						
Garfield Township.....	B	730						10-4-10
Garfield Township.....	B	850						10-4-10
Garfield Township.....	B	1179						10-4-10
Garfield Township.....	B	1745						10-4-10
Garfield Township.....	B	-						

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Garfield Township—Total last report.	B	1747 1748	3-16-12 3-16-12	1.000 .641	County. County.
Green Lake Township.....	B	1138	1-3-11	1.004	1.004	\$976 00
Mayfield Township.....	B	979 1226	7-28-10 6-10-11	1.004 1.008	1.004	\$502 00
Mayfield Township.....	B	1176 1458	3-18-11 8-3-11	1.066 1.060	1.006 1.000	\$502 00
Paradise Township—Total last report.	B	820	.....	1.000	1.000	\$500 00
Paradise Township.....	B	1176	3-18-11	1.066	1.066	533 00
Paradise Township.....	B	1458	8-3-11	1.060	1.060	500 00
Peninsula Township—Total last report.....	B	559 848 1570	.....	3.066	3.066	\$1,533 00
Whitewater Township—Total last report.....	B	559	.....	1.000	1.050	\$1,025 00
Whitewater Township.....	B	848	.....	3.712	2.050	340 00
Whitewater Township.....	D	1570	9-7-11	.313	.313	461 00
Clinton County:	.....	.....	.....	4.025	4.025	\$2,091 00
Arada Township—Total last report.	B	336 702	.....	9.054	7.032	\$3,516 00
Arada Township.....	B	703	.....	.....	.038	100 00
Arada Township.....	B	1114	11-9-10	1.000	1.000	492 00
Arada Township.....	B	1115	11-9-10	1.000	1.000	487 00
Arada Township.....	B	1544	8-28-11	1.004	1.004	500 00
Arada Township.....	B	1625	10-11-11	1.000	1.000	502 00
Arada Township.....	A	1626	10-11-11	.756	.....	.....
Bethany Township—Total last report.	B	1019 1079 1270 1572 1633	8-18-10 10-5-10 5-18-11 9-8-11 10-11-11	5.246 1.000 1.232 1.000 .518	3.482 1.000 1.232 1.000 .518	\$1,746 00
Bethany Township.....	B	1019	8-18-10	1.000	1.000	500 00
Bethany Township.....	B	1079	10-5-10	1.000	1.000	616 00
Bethany Township.....	B	1270	5-18-11	1.000	1.000	500 00
Bethany Township.....	B	1572	9-8-11	1.025	1.025	512 00
Bethany Township.....	B	1633	10-11-11	.....	.....	256 00
Emerson Township—Total last report.	B	610 611	.....	10.021	8.267	\$4,133 00
Emerson Township.....	B	610	.....	11.000	7.988	\$3,894 00
Emerson Township.....	B	611	.....	.....	1.000	600 00
Emerson Township—Total last report.	1.000	7-7-10
Emerson Township.....	500 00	8-30-11

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TABLE NO. 10.—Continued.

County and township.	Class.	Number of applications.	Date of application.	Length.	Applied for.	Built.	Reward paid.	Date of payment.	Built by.	Remarks.
Gratiot County—Con.										
Emerson Township	B	613	9-9-10	1,000			\$500 00	7-7-10	Township.	
Emerson Township	B	1053	9-9-10	1,000					Township.	
Emerson Township	B	1054	9-9-10	994					Township.	
Emerson Township	B	1055	9-9-10	1,000					Township.	
Emerson Township	B	1089	10-3-10	1,000	1,000	1,000	500 00	8-30-11	Township.	
Emerson Township	B	1442	8-3-11	1,000	1,000	1,000	500 00	8-30-11	Township.	
Emerson Township	B	1718	2-20-12	1,000					Township.	
Emerson Township	B	1719	2-20-12	1,000					Township.	
Emerson Township	B	1717	2-20-12	1,000					Township.	
Emerson Township	B	1764	3-22-12	1,000					Township.	
Fulton Township	B	1630	10-11-11	500	500	502	\$250 00	1-20-12	Township.	
Fulton Township	B	1631	10-11-11	502			251 00	1-20-12	Township.	
Fulton Township	B	1632	10-11-11	498	498		249 00	1-29-12	Township.	
Newark Township—Total last report.				1,300	1,500		\$750 00			
Newark Township	B	494	12-2-10	1,000					Township.	
Newark Township	B	1128	5-10-11	1,004	1,004	1,004	500 00	3-28-11	Township.	
Newark Township	B	1237	5-10-11	996	996	996	502 00	1-5-11	Township.	
Newark Township	B	1492	8-9-11	992	992	992	488 00	7-14-11	Township.	
Newark Township	B	1483	8-9-11	1,004	1,004	1,004	486 00	10-3-11	Township.	
Newark Township	B	1484	8-9-11	1,004	1,004	1,004	502 00	6-12-12	Township.	
Newark Township	B	1485	8-9-11	1,000	1,000	1,000			Township.	
Newark Township	B	1643	10-16-11	502					Township.	
					8,502	5,996	\$2,998 00			
New Haven Township—Total last report.	A	700			2,000					
New Haven Township	A	701					1,000			
New Haven Township	A	1460					1,000	\$250 00		
New Haven Township	A	1768					1,004	251 00		
New Haven Township	A	1776					1,000			
North Star Township—Total last report.					4,504	3,004	\$751 00			
					2,000	1,000	\$500 00			

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Pine River Township—Total last report.....	B	486	11.468	9.000	\$4,500.00	Township,
Pine River Township.....	B	742472	236.00	10-27-10 Township,
Pine River Township.....	B	743	.....	.....	.996	498.00	9-21-11 Township,
Pine River Township.....	B	1507	8-16-11	1.010	1.000	500.00	10-27-10 Township,
Pine River Township.....	B	1532	8-28-11	1.500	1.010	505.00	9-21-11 Township,
Pine River Township.....	B	.....	.....	13.978	13.978	750.00	1-24-12 Township,
Serville Township—Total last report.....	B	1158	2-20-11	1.022	.....	.....	Township,.....
Serville Township.....	B	1210	4-7-11	1.000	1.000	500.00	.....
Serville Township.....	B	1523	8-25-11	1.004	.500	250.00	8-11-11 8-18-11 Township, Township, Township,
Summer Township—Total last report.....	B	901	.....	4.026	1.500	\$750.00	Township,.....
Summer Township.....	B	1118	11-10-10	1.000	.....	.....	Cancelled.
Summer Township.....	B	1119	11-10-10	1.010	1.010	505.00	1-5-11 Township,
Summer Township.....	B	1701	12-22-11	1.000	1.000	600.00	8-21-12 Township,
Summer Township.....	B	1885	6-19-12	.500	.500	250.00	6-21-12 Township,
Washington Township.....	B	1397	7-18-11	.488	.488	\$244.00	9-10-11 Township,
Washington Township.....	B	1398	7-18-11	.600	.500	250.00	9-16-11 Township,
Washington Township.....	A	1461	8-1-11	.992	.992	248.00	9-16-11 Township,
Washington Township.....	A	1462	8-1-11	1.178	.....	.....	.....
Wheeler Township.....	A	1463	8-1-11	.500	.500	\$250.00	3-19-12 Township,
Wheeler Township.....	A	1617	10-4-11	.996	.996	124.00	3-19-12 Township,
Wheeler Township.....	A	1618	10-4-11	.471	.471	118.00	3-19-12 Township,
Wheeler Township.....	B	1618	10-4-11	.525	.525	262.00	3-19-12 Township,
Wheeler Township.....	B	1619	10-4-11	1.000	1.000	500.00	3-19-12 Township,
Wheeler Township.....	B	1620	10-4-11	1.000	1.000	500.00	3-19-12 Township,
Hillsdale County:				3.992	2.992	\$1,254.00	
Allen Township.....	B	1384	7-14-11	1.042	1.042	\$521.00	12-7-11 Township,
Camden Township—Total last report.....	B	.....	.....	3.738	2.001	\$1,000.00	Township,
Camden Township.....	B	.....	.....	.....	.384	192.00	7-15-10 Township,
Camden Township.....	B	690	.....	.....	1.353	676.00	6-28-11 Township,
Camden Township.....	B	1368	8-10-11	1.004	1.004	602.00	6-14-12 Township,
Camden Township.....	B	1489	8-10-11	.502	.502	251.00	6-14-12 Township,
Camden Township.....	B	1649	9-5-11	.748	.....	.....	.....
				5.990	5.244	\$2,621.00	

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Number of application [See Date of application.	Length. Applied for. Built.	Reward paid.	Date of payment.	Built by.	Remarks.
Hillsdale County—Con.						
Fayette Township.....	B 1445 B 1446	8-3-11 8-3-11	.626 .378	.626 .378	\$313.00 189.00	11-17-11 11-17-11 Township. Township.
Reading Township.....	B 1095 B 1096 B 1425 B 1436 B 1910 B 1911	10-11-10 10-11-10 7-28-11 7-28-11 6-25-12 6-25-12	.498 .502 1.320 .506 .500	.498 .502 1.320 .506 .500	\$249.00 251.00 760.00 253.00	6-14-11 6-14-11 7-Township. 7-Township. 6-18-12 Township. Township. Township.
Woodbridge Township.....	B 1024 B 1021 B 1650 B 1765	8-18-10 8-18-10 10-20-11 3-26-12	1.028 1.482 1.000 1.028	1.028 1.482 1.000 1.028	\$514.00 500.00	11-21-10 7-14-11 Township. Township. Township.
Houghton County:						
Franklin Township.....	E 1180 E 1181 E 1182 E 1186	3-18-11 3-18-11 3-18-11 3-27-12	.947 1.061 1.061 1.450	1.061 1.061 1.373 1.450	\$1,061.00 373.00	County. County. County. County.
Oceola Township.....	E 1183	3-18-11	2.196	1.434	\$1,434.00	1-9-12 County.
Portage Township—Total last report.....	E 1167	3-27-12	2.643	.984	\$894.00	1-9-12 County.
Huron County:						
Brookfield Township.....	A 1179 A 1180	4-11-12 4-11-12	1.000 .990	3.643		Township. Township.

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								Township. Township.
A	1781 1782	4-11-12 4-11-12	1,000 1,000					
			3,990					
Colfax Township	B	1265	5-17-11	496				Township.
Colfax Township	B	1266	5-17-11	496				Township.
Colfax Township	B	1267	5-17-11	1,008	1,008	\$504.00		Township.
Colfax Township	B	1268	6-24-12	.612				Township.
Colfax Township	B	1269	6-24-12	1,004				Township.
			4,016	1,008		\$504.00		
Grant Township	B	1571	9-7-11	1,000				Township.
			1,458					
McKinley Township—Total last report								
Oliver Township	C	987	7-30-10	1,006	1,006	\$754.00	6-18-12	Township.
Oliver Township	C	988	7-30-10	1,010	1,010	758.00	6-18-12	Township.
Oliver Township	C	989	7-30-10	1,000	.500	375.00	11-24-11	Township.
Oliver Township	C	1429	8-3-11	.500	.500	375.00	11-24-11	Township.
			3,516	3,016		\$2,262.00		
Sand Beach Township—Total last report								
Sand Beach Township	B	590		5,344	4,022	\$2,543.00	Township.	
Sand Beach Township	B	894			.302	151.00	8-8-10	
Sand Beach Township	B	962	8-4-10		1,020	510.00	6-28-11	
Sand Beach Township	B	963	8-4-10	.992				
Sand Beach Township	B	1294	6-28-11	1,042	1,042	521.00	7-14-11	
Sand Beach Township	B	1324	6-28-11	1,060	1,060	530.00	12-15-11	
Sand Beach Township	B	1363	7-1-11	1,036	1,036	518.00	1-3-12	
			9,474	8,482		\$4,773.00		
Scheweing Township—Total last report								
Scheweing Township	E	582		3,797	2,045	\$2,045.00	Township.	
Scheweing Township	E	583			.500	500.00	9-8-10	
Scheweing Township	E	629			.250	250.00	9-8-10	
Scheweing Township	E	1242	5-10-11	.500	1,002	1,002.00	9-8-10	
Scheweing Township	E	1243	5-10-11	.500	.500	500.00	10-14-11	
Scheweing Township	E	1783	5-6-12	1,000				
			5,707	4,797		\$4,797.00		
Sigel Township	B	1364	7-1-11	1,044	1,044	1,044	11-24-11	Township.
Sigel Township	B	1365	7-1-11	.980	.980	490.00	11-24-11	Township.
			2,024	2,024		\$1,012.00		
Verona Township—Total last report								
Verona Township	B	1233	5-10-11	1,002	1,002	\$501.00	Township.	

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Number of applications. [See Appli- cation for]	Date of application.	Length. Applied for.	Reward paid.	Date of payment.	Built by.	Remarks.
Huron County—Con.							
Verona Township.....	B 1234	5-10-11	.494	1.004	\$502 00	1-29-12	Township.
Verona Township.....	B 1235	5-10-11	2.936	2.006	\$1,003 00		Township.
Windsor Township—Total last report.....			7.051	3.929	\$2,929 00		Township.
Windsor Township.....	E 830	.....	.501	.501	501 00	10-24-11	Township.
Windsor Township.....	E 831	.....	500	500	500 00	10-4-10	Township.
Windsor Township.....	E 832	.....	500	500	500 00	10-4-10	Township.
Windsor Township.....	E 1245	5-10-11	.500	.500	500 00	10-24-11	Township.
Windsor Township.....	E 1246	5-10-11	.570	.688	38 00	10-24-11	Township.
Windsor Township.....	E 1247	5-10-11	1.004	.....	.....	.....	Township.
Ingham County—Alfredon Township—Total last report.....			9.125	5.983	\$3,968 00		Township.
Aurelius Township.....	B 998	8-9-10	1.006	.....	.....	.....	Township.
Aurelius Township.....	B 999	8-9-10	.522	.522	\$261 00	6-28-11	Township.
Aurelius Township.....	B 1306	6-7-11	.504	.504	252 00	6-28-11	Township.
Aurelius Township.....	B 1307	6-7-11	1.004	.....	.....	.....	Township.
Aurelius Township.....	B 1559	9-6-11	1.258	.....	.....	.....	Township.
Aurelius Township.....	B	9-6-11	1.022	.....	.....	.....	Township.
Lansing Township—Total last report.....			4.310	1.026	\$513 00		Township.
Lansing Township.....	B 570	.....	5.000	3.000	\$2,500 00	7-7-10	Township.
Lansing Township.....	B 590	.....	1.406	1.000	500 00	5-16-11	Township.
Lansing Township.....	B 1325	6-19-11	1.164	1.164	582 00	6-18-12	Township.
Lansing Township.....	B 1870	6-17-12	.502	.....	.....	.....	Township.
Lansing Township.....	B 1890	6-19-12	1.000	.....	.....	.....	Township.
Lansing Township.....	B	6-19-12	7.866	5.690	\$3,830 00		Township.
Leroy Township—Leroy Township—Total last report.....	B 1244	5-10-11	.516	.516	\$258 00	9-1-11	Township.
Leroy Township—Leroy Township—Total last report.....	B 1448	8-3-11	.500	.500	250 00	9-1-11	Township.
Meridian Township—Meridian Township—Total last report.....			1.016	1.016	\$508 00		Township.
Meridian Township—Meridian Township—Total last report.....			2.448	2.160	\$1,080 00		Township.

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Onondaga Township.....	B	1669	11-3-11	.350		Township.
White Oak Township—Total last report.....			1.006			Township.
Ionia County:						
Berlin Township.....	B	1081	9-21-10	1.991	1.991	Township.
Ionia Township—Total last report.....	B	1080	9-21-10	1.061	\$996 00	6-28-11 Township.
Ionia Township.....	B	1841	6-1-12	1.744	\$872 00	Township.....
Ionia Township.....	B		1.738			Township.....
Lyons Township—Total last report.....						Cancelled.
North Plains Township.....	B	1275	5-23-11	1.010		Township.....
Orange Township.....	B	1082	9-21-10	1.504	\$732 00	6-29-11 Township.
Orange Township.....	B	1820	5-22-12	1.500	750 00	6-28-12 Township.
Orleans Township.....	B	1087	9-30-10	1.006	\$503 00	1-5-11 Township.
Orleans Township.....	B	1403	7-20-11	1.756		Township.....
Otisco Township—Total last report.....						
Otisco Township.....	B	339		1.050	\$525 00	8-30-10 Township.
Otisco Township.....	B	1634	10-11-11	2.022		Township.....
Ieeeo County:						
Alabaster Township.....	A	1574	9-9-11	1.344		County.
Au Sable Township—Total last report.....				2.000		Township.....
Grant Township—Total last report.....				.152		County.
Grant and Reno Townships—Total last report				2.500	2.428	\$2,428 00 County.
Reno Township.....	E	1334	6-20-11	1.453		County.
Sherman Township.....	E	1105	10-25-10	1.483	\$1,483 00	6-28-11 County.
Tawas Township.....	B	1573	9-9-11	1.394		County.
Tawas Township.....	A	1838	6-25-12	284		Township.
Tawas Township.....	A	1909	6-25-12	728		Township.
				2.406		

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—*Continued.*

County and township.	Number of suppliers.	Date of application.	Length.	Reward paid.	Built by.	Remarks.
			Applied for. Built.			
Iron County: Bates Township.....	C B	1569 1696	9-7-11 12-11-11	.443 3.056	.....	County, County.
Crystal Falls Township—Total last report.....	B	1077	9-19-10	1.320	\$660.00	County.
Crystal Falls Township.....	B	1155	2-10-11	1.326	663.00	County.
Crystal Falls Township.....	B	1583	9-7-11	.384	192.00	County.
Crystal Falls Township.....	E	1559	10-26-11	3.363	2.386	County.
Crystal Falls Township.....	E	1559	10-26-11	3.995	1.193.00	County.
Iron River Township	B	1688	10-31-11	1.296	.....	County.
Mansfield Township.....	E	1660	10-26-11	1.415	.....	County.
Isabella County: Clippers Township.....	B	1970	6-25-12	1.980	.....	Township.
Coe Township—Total last report.....	B	740	.....	7.256	\$1,993.00	Township.
Coe Township.....	B	741	.....	1,500	750.00	Township.
Coe Township.....	B	1065	9-13-10	1,504	882.00	Township.
Coe Township.....	B	1153	2-9-11	1,004	752.00	Township.
Coe Township.....	B	1150	2-20-11	500	.....	Township.
Coe Township.....	B	1180	2-20-11	500	.....	Township.
Coe Township.....	B	1161	2-20-11	500	.....	Township.
Coe Township.....	B	1575	9-9-11	2,000	.....	Township.
Isabella Township—Total last report.....	B	891	.....	13,264	8,758	Township.
Isabella Township.....	B	1091	10-13-10	1,041	1,022	Township.
Isabella Township.....	B	1742	3-16-12	500	.500	Township.
Isabella Township.....	B	1743	3-16-12	500	1,000	Township.
Isabella Township.....	B	1791	4-30-12	500	.....	Township.
Isabella Township—Total last report.....	B	891	.....	1,022	\$511.00	Township.
Isabella Township.....	B	1091	10-14-10	1,041	250.00	Township.
Isabella Township.....	B	1742	10-14-11	500	.....	Township.
Isabella Township.....	B	1743	10-14-11	500	Township.
Isabella Township.....	B	1791	10-14-11	500	Township.

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Lincoln Township—Total last report.....	B	754	2,025	1,000	\$800.00	Township.
Lincoln Township.....	B	1512	8-17-11	.500	1,025	512.00	9-18-11	Township.
Lincoln Township.....	B	1513	8-17-11	.500	.500	250.00	9-18-11	Township.
Lincoln Township.....	B	1614	8-17-11	.500	.500	250.00	9-18-11	Township.
Lincoln Township.....	B	1578	9-12-11	2,008	.....	250.00	9-18-11	Township.
Lincoln Township.....	B	.....	.....	6,533	3,525	\$1,762.00	.....	Township.
.....	B	1279	5-24-11	1,000	.....	.....	.....	.....
Nottawa Township.....	B	1490	8-10-11	1,004	.....	.....	.....	Township.
Rolland Township.....	B	1491	8-10-11	1,000	.....	.....	.....	Township.
.....	B	.....	.....	2,004	.....	.....	.....	.....
Sherman Township.....	B	1132	12-8-10	1,000	.....	.....	.....	Township.
Sherman Township.....	B	1133	12-8-10	1,000	.....	.....	.....	Township.
Sherman Township.....	B	1790	4-30-12	1,000	.....	.....	.....	Township.
.....	B	.....	.....	3,000	.....	.....	.....	.....
Union Township.....	B	939	7-2-10	.504	.504	\$252.00	7-14-11	Township.
Union Township.....	B	1070	9-13-10	.500	.500	250.00	10-27-10	Township.
Union Township.....	B	1071	9-13-10	.500	.500	250.00	5-22-11	Township.
Union Township.....	B	1072	9-13-10	.511	.511	255.00	10-27-10	Township.
Union Township.....	B	1367	7-5-11	.500	.500	250.00	9-7-11	Township.
Union Township.....	B	1368	7-5-11	.500	.500	250.00	9-7-11	Township.
Union Township.....	B	1553	9-11-11	.500	.....	.....	.....	.....
.....	B	.....	.....	3,515	3,015	\$1,507.00	.....	.....
Vernon Township—Total last report.....	B	561	.....	2,966	1,008	\$364.00	.....	Township.
Vernon Township.....	B	526	Extension	.012	1,000	500.00	6-28-11	Township.
Vernon Township.....	B	1281	5-26-11	1,000	1,000	500.00	9-14-11	Township.
Vernon Township.....	B	1282	5-26-11	1,000	1,000	500.00	.....	.....
Vernon Township.....	B	1285	9-19-11	1,000	1,000	500.00	.....	.....
Vernon Township.....	B	1810	6-15-12	1,000	1,000	500.00	.....	.....
Vernon Township.....	B	1812	6-15-12	.994	.....	.....	.....	.....
.....	B	.....	.....	8,002	3,008	\$1,504.00	.....	.....
Jackson County:								
Hanover Township.....	E	985	7-30-10	.500	.500	\$400.00	1-5-11	Township.
Hanover Township.....	E	986	7-30-10	.500	.500	300.00	1-5-11	Township.
Hanover Township.....	E	1112	11-7-10	.888	.888	500.00	6-28-11	Township.
.....	A	1459	7-3-11	4,008	4,008	\$3,004.00
Hennetta Township—Total last report.....	A	5,106	5,008	\$3,254.00	10-9-11	Township.

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TABLE NO. 10.—Continued.

County and township.	Class.	Number of applicants.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
			Applied for.	Built.				
Jackson County—Con.								
Parma Township.....	E	1236	5-10-11	1,000				
Parma Township.....	B	1313	6-13-11	1,000	1,000	\$500 00	9-25-11	Township.
Springport Township—Total last report.....	B	903	.....	2,000	1,000	\$500 00		Township.
Springport Township.....	B	1496	8-10-11	1,006	1,006	\$500 00	10-4-11	Township.
Springport Township.....	B	1497	8-10-11	.504	.504	500 00	9-25-11	Township.
Springport Township.....	B	1498	8-10-11	.504	.504	250 00	9-25-11	Township.
Tompkins Township.....	B	1881	6-17-12	1,562				Township.
Kalamazoo County—Total last report.....	B	772	.....	2,000	1,000	\$500 00	10-24-11	County.
Alamo Township.....	B	782	.....		1,000	500 00	1-8-11	County.
Alamo Township.....	B	1104	2-23-11	.500				County.
Alamo Township.....	B	1165	2-23-11	1,000				County.
Alamo Township.....	B	1166	2-23-11	.500				County.
Alamo Township.....	B	1149	3-18-12	.498				County.
Brady Township—Total last report.....	B	768	.....	2,000	1,000	\$500 00	8-4-10	County.
Brady Township.....	B	769	.....		1,000	500 00	11-1-10	County.
Brady Township.....	B	1194	3-28-11	1,000	.800	250 00	9-14-11	County.
Brady Township.....	B	1195	3-28-11	1,000	.890	445 00	6-28-11	County.
Brady Township.....	B	1675	11-18-11	.348				County.
Brady Township.....	B	1756	3-18-12	.750				County.
Charleston Township—Total last report.....	B	770	.....	2,000	1,000	\$500 00	9-13-10	County.
Charleston Township.....	B	778		1,000	500 00	1-8-11	County.
Charleston Township.....	B	1197	3-28-11	1,000	1,000	500 00	7-26-11	County.

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Charleston Township—Total last report.	B	1198 1757	3-28-11 3-18-12	1,000 1,000	3,000	\$1,500.00	County. County.
Climax Township—Total last report.	B	763 764 1257 1258	6-17-11 6-17-11	1,000 1,000	1,000 1,000	\$500.00 \$500.00	County. County. County. County.
Constock Township—Total last report.	B	773 1188 1762	2-23-11 3-18-12	2,000 500	2,000 1,080	\$1,000.00 \$40.00	County. County. County.
Cooper Township—Total last report.	B	775 776 1170 1261 1264 1677 1678	2-23-11 1,000 .500	2,000 830 170 170 246 246	2,000 1,000 1,000 .500	\$1,000.00 \$500.00 \$500.00 \$20.00	County. County. County. County. County. County.
Kalimazoo Township—Total last report.	B	579 758 757 1191 1750 1751 1808 1809	3-28-11 3-18-12 3-18-12 3-18-12 3-18-12 6-15-12 6-15-12	530 606 857 1,718 508 .500 1,002	530 606 857 1,718 508 .500 1,002	\$265.00 697.00 323.00 7-26-11	County. County. County. County.
Osthemno Township—Total last report.	B	1167 1192 1259 1759 1762	2-23-11 3-28-11 5-17-11 3-18-12 3-18-12	2,000 .250 .875 1,000 .250	2,000 .250 .875 1,000 .250	\$500.00 125.00	County. County. County. County. County.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Date of application.	Length.	Reward paid.	Built by.	Remarks.
		Applied for.	Built.		
Kalamazoo (County—Con.)					
Pavilion Township—Total last report.					
Pavilion Township.....	B 774	2,000	\$1,000.00	6-21-11	County.
Pavilion Township.....	B 1193	1,000	2,000	6-21-11	County.
Pavilion Township.....	B 1262	1,020	.500	9-6-11	County.
Pavilion Township.....	B 1758	.500	1,250	9-6-11	County.
Portage Township—Total last report.					
Portage Township.....	B 770	2,000	1,000	\$500.00	10-14-10
Portage Township.....	B 771	1,000	1,000	500.00	8-4-10
Portage Township.....	B 937	7-10	.568	.....	County.
Portage Township.....	B 1196	3-28-11	1,000	1,000	Township.
Portage Township.....	B 1280	5-17-11	1,000	500.00	County.
Portage Township.....	B 1754	3-18-12	1,000	1,000	County.
Portage Township.....	B 1761	3-18-12	1,000	1,000	County.
Prairie Ronde Township—Total last report.					
Prairie Ronde Township.....	E 762	2,000	1,000	\$1,000.00	9-18-11
Prairie Ronde Township.....	B 1516	8-18-11	2,000	327.00	County.
Prairie Ronde Township.....	B 1516	8-18-11	2,000	327.00	County.
Richland Township—Total last report.					
Richland Township.....	B 779	2,000	1,654	\$1,327.00	10-24-11
Richland Township.....	B 1162	2-23-11	.758	.....	County.
Richland Township.....	B 1163	2-23-11	1,242	379.00	County.
Richland Township.....	B 1623	10-6-11	.250	250.00	Township.
Richland Township.....	B 1688	10-6-11	.500	140.00	County.
Richland Township.....	B 1753	3-18-12	.500	250.00	1-18-12
Richland Township.....	B 1753	3-18-12	.500	50.00	1-3-12
Ross Township—Total last report.					
Ross Township.....	B 780	2,000	4,038	\$2,019.00	9-6-11
Ross Township.....	B 781	2,000	1,988	262.00	County.
Ross Township.....	B 1169	2-23-11	1,739	1,739	County.
Ross Township.....	B 1169	2-23-11	2,000	198	County.

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Schoolecraft Township—Total last report.....	D	765	2,033	1,000	750.00	1-6-11	County.	
Schoolecraft Township.....	B	766	1,033	516.00	8-12-11	County.		
Schoolecraft Township.....	B	1263	5-17-11	1,236	618.00	9-14-11	County.	
Schoolecraft Township.....	B	1755	3-18-12	.550	.....	.....	County.
Schoolecraft Township.....	B	1760	3-18-12	.224	.....	.....	County.
Texas Township—Total last report.....	B	767	4,757	3,260	\$1,884.00	.....	.....
Texas Township.....	B	1517	2,002	1,761	\$890.00	6-21-11	County.	
Texas Township.....	A	1676	2,000	.500	.....	.....	County.
Texas Township.....	A	1676	11-18-11	.500	.....	.....	County.
Wakeshma Township—Total last report.....	E	761	4,502	1,761	\$890.00	.....	.....
Wakeshma Township.....	E	1883	2,000	.904	\$894.00	9-18-11	County.	
Wakeshma Township.....	E	1883	9-21-11	2,000	.....	.....	County.
Kalkaska County:			4,000	.994	\$894.00	.....	.....
Boardman Township—Total last report.....	B	1289	3,156	3,156	\$2,578.00	6-12-12	County.	
Boardman Township.....	B	1875	6-1-11	.750	375.00	6-12-12	County.	
Boardman Township.....	B	1875	7-11-11	.550	.....	.....	County.
Clearwater Township—Total last report.....	B	645	5,327	4,008	\$2,004.00	7-15-10	County and township.	
Clearwater Township.....	B	646	.....	1,000	4.00	8-30-10	Township.
Clearwater Township.....	B	753	.....	1,511	255.00	6-18-12	Township.
Clearwater Township.....	B	1059	8-15-10	1,000	500.00	6-18-12	Township.	
Clearwater Township.....	B	1519	8-19-11	.500	250.00	3-18-12	Township.	
Clearwater Township.....	B	1820	8-19-11	.934	.500	250.00	Township.	
Clearwater Township.....	B	1646	10-10-11	.644	.644	322.00	6-18-12	Township.
Clearwater Township.....	E	1837	6-1-12	1,000	.....	.....	County.
Clearwater Township.....	B	1849	6-8-12	.498	.....	.....	Township.
Clearwater Township.....	B	1850	6-8-12	.372	.....	.....	Township.
Clearwater Township.....	B	1851	6-8-12	.308	.....	.....	Township.
Cold Springs Township—Total last report.....	B	1303	10,583	8,171	\$4,085.00	.....	.....
Cold Springs Township.....	B	1855	6-6-11	1,058	1,058	9-27-11	Township.	
Cold Springs Township.....	B	1856	6-8-12	1,012	.....	.....	Township.
Cold Springs Township.....	B	1856	6-1-12	.994	.....	.....	County.
Excelsior Township—Total last report.....	.....	.....	3,064	1,058	\$529.00	.....	.....
Cold Springs and Rapid River Townships—Total last report.....	.....	.....	1,008	1,008	\$504.00	.....	.....
Excelsior Township—Total last report.....	.....	.....	1,000	1,000	\$750.00	.....	County.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
	Class.	Number of application.	Applied for.	Built.			
Kalkaska County—Con.							
Garfield Township—Total last report.....	B	1066	9-13-10	1,498 1,005	1,000	\$500.00	County and township.
Garfield Township.....				2,503	1,000	\$500.00	County.
Kalkaska Township.....	B	1647	10-20-11	.500	.....	.....	County.
Kalkaska Township.....	A	1682	11-18-11	.500	.....	.....	County.
Orange Township—Total last report.....				1,000	.....	.....	County.
Rapid River Township—Total last report.....	B	752	.....	1,254	1,254	\$627.00	County.
Rapid River Township.....	B	754	.....	3,002	1,500 1,000 .498	\$750.00 500.00 246.00	10-27-10 11-2-10 County.
Springfield Township—Total last report.....				3,002	2,998	\$1,498.00	County.
Wilson Township—Total last report.....				1,400	1,400	\$350.00	County.
Kent County:				2,218	2,218	\$1,100.00	County.
Alpine Township.....	B	1292	6-2-11	1,000	1,000	\$500.00	6-28-11 District.
Bowne Township.....	B	1,127	11-25-10	1,000	.....	.....	Township.
Byron Township—Total last report.....				1,000	1,000	\$500.00	Township.
Grand Rapids Township—Total last report.				5,833	3,000 .248 .630 .500 .500	\$1,500.00 124.00 315.00 250.00 250.00	District.
Grand Rapids Township.....	B	346	.....	.....	.....	.....	District.
Grand Rapids Township.....	B	630	.....	.....	.....	.....	District.
Grand Rapids Township.....	B	915	.....	.....	.....	.....	District.
Grand Rapids Township.....	B	916	.....	.....	.....	.....	District.
Grand Rapids Township.....	B	1,187	3-2-11	.994	.....	.....	Township.
Grand Rapids Township.....	B	1,190	3-24-11	1,484	.....	.....	District.
Grand Rapids Township.....	B	1,291	6-2-11	1,000	1,000	.....	District.
Grand Rapids Township.....	B	1,335	10-2-11	1,090	545.00	545.00	10-4-11 District.
				10,501	5,988	\$2,984.00	

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Lowell Township.....		B	1714	2-13-12	1,006		Township.
Paris Township—Total last report.		B	1189	3-24-11	2,594	\$797.00	District.
Paris Township.....					1,000	500.00	District.
Plainfield Township—Total last report.		B	598		2,000	1,010	District.
Plainfield Township.....		B	631		.500	\$505.00	District.
Plainfield Township.....		B	1186	3-23-11	1,080	245.00	District.
Plainfield Township.....		B	1188	3-24-11	.531	245.00	Township.
Plainfield Township.....					.531	245.00	District.
Sparta Township—Total last report.		B	185		3,611	2,531	District.
Sparta Township.....		B	1124	11-28-10	4,060	3,996	District.
Sparta Township.....		B	1125	11-28-10	1,022	1,022	District.
Sparta Township.....		B	1126	11-28-10	.510	.510	District.
Sparta Township.....					.510	245.00	Township.
Tyrone Township—Total last report.		E	520		6,102	\$3,051.00	Township.
Tyrone Township.....		E	824	Extension.	11,488	10,002	Township.
Tyrone Township.....		E	825		.013	\$6,000.00	Township.
Tyrone Township.....		E	1067	10-14-10	.986	\$13,00	Township.
Tyrone Township.....		B	1492	8-10-11	1,060	498.00	Township.
Tyrone Township.....		B	1493	8-10-11	.500	500.00	Township.
Tyrone Township.....					.492	500.00	Township.
Walker Township—Total last report.		B	1068	9-13-10	13,553	12,061	Township.
Walker Township.....		B	1340	6-2-11	2,086	1,546	Township.
Walker Township.....		B	1341	6-2-11	1,000	1,004	Township.
Walker Township.....					1,028	502.00	Township.
Wyoming Township—Total last report.		B	569		5,098	4,578	Township.
Wyoming Township.....		B	1068	9-13-10	1,000	490	Township.
Wyoming Township.....		B	1558	9-6-11	1,540	1,532	Township.
Wyoming Township.....					2,026	766.00	Township.
Wyoming Township.....						2,022	Township.
Wyoming County.....							
Alloes Township—Total last report.							
Alloes Township.....							

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Number of application.	Date of application.	Length.	Applied for.	Reward paid.	Date of payment.	Built by.	Remarks.
Lake County:									
Ellsworth Township - Total last report.....	B	920	.....	2 088	1 050	\$525 00	.....	Township.	
Ellsworth Township.....	B	1000	10-2-11	3 044	1 000	500 00	11-22-11	Township.	
Ellsworth Township.....	B	1610	10-2-11	.974	.500	750 00	11-22-11	Township.	
						250 00	11-22-11	Township.	
Newkirk Township - Total last report.....	B	1050	9-2-10	2 000	2 000	\$1 000 00	.....	Township.	
Newkirk Township.....	B	1353	6-29-11	1 016	.500	250 00	6-8-12	Township.	
Newkirk Township.....	B	1354	6-29-11	1 004	1 000	500 00	3-23-11	Township.	
Newkirk Township.....	B	1352	6-29-11	2 040	1 000	500 00	5-22-12	Township.	
Newkirk Township.....	B	1356	6-29-11	.946	.986	454 00	1-24-12	Township.	
						250 00	1-24-12	Township.	
Lapeer County:									
Almont Township - Total last report.....	B	361	.....	4 535	1 514	\$757 00	.....	Township.	
Almont Township.....	B	866	.....	.....	.484	542 00	3-23-11	Township.	
Almont Township.....	B	867	.....	.....	.726	383 00	3-23-11	Township.	
Almont Township.....	B	868	.....	.....	.379	190 00	3-23-11	Township.	
Almont Township.....	B	1504	9-20-11	1 012	1 125	563 00	9-21-11	Township.	
Almont Township.....	B	1703	1 4-12	1 564	.500	250 00	2-5-12	Township.	
Inlaiy Township - Total last report.....	B	1318	6 15 11	7 111	4 728	\$2,365 00	.....	Township.	
Inlaiy Township.....	B	1319	6 15 11	.500	.500	250 00	12-22-11	Township.	
Inlaiy Township.....	B	1638	10 13 11	.500	.500	250 00	12-22-11	Township.	
Mayfield Township.....	B	1621	10 5 11	2 340	2 000	\$300 00	.....	Township.	
North Branch Township - Total last report.....	.....	.....	.....	1 306	.....	.....	.....	Township.	
Leelanau County:									
Bingham Township.....	B	120	7-26-11	1 008	Township.	
Empire Township.....	B	1640	8-28-11	2 010	Township.	

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Lemire County; Oordon Township—Total last report.		4,000	Township.....	Cancelled.
Tecumseh Township—Total last report.		2,000	.....	Township.....	Cancelled.
Livingston County; Brighton Township.....	B	1860	6-14-12 1,000	.....	Township.
Cohocton Township.....	B	1567	9-7-11 1,988	.....	Township.
Conway Township.....	B	1287	6-29-11 .987	.....	Township.
Deerfield Township.....	B	1882	6-18-12 1,000	.....	Township.
Genesee Township.....	B	1697	12-11-11 1,016	.....	Township.
Handy Township.....	B	1670	11-3-11 1,250	.....	Township.
Hartland Township.....	B	1840	6-1-12 2,032	.....	Township.
Howell Township—Total last report.		2,000	.....	Township.	
Howell Township.....	B	1121	11-15-10 6-21-11	2,000 .834	1-6-11 11-0-11
Howell Township.....	B	1336	6-21-11	.834	282 00
Howell Township.....	B	1337	6-21-11	2,796	9-6-11
					Township.
Iosco Township;— Iosco Township.....	B	1694	12-5-11 6-1-12	1,140 1,044	.....
					Township.
Marion Township;— Marion Township.....	B	1227	5-10-11 5-10-11	1,000 1,000	\$500 00
	B	1228	12-22-11	.1322	.....
	B	1700		1,132	68 00
					1-3-12
Oceola Township;— Oceola Township.....	B	1217	5-10-11 4-22-12	2,000 1,0112	\$566 00
	B	1754	6-25-12	1,114	.....
	B	1836			11-17-11
Putnam Township;— Putnam Township.....	B	1231	5-10-11 6-1-12	2,000 3,000	\$1,000 00
	B	1838			9-16-11
Unadilla Township.....	B	1863	6-15-12 3,000	2,000	\$1,000 00
					Township.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Date of application. Year number of application.	Length. Applied for.	Reward paid. Built.	Date of payment. Built by.	Remarks.
Luce County: McMillian Township—Total last report.....	D	25.....	1,240.....	.666 .333	\$500.00 250.00	8-1-10 County. County.
Macomb County: Armenia Township.....	B	1843.....	1,240.....	.899	\$750.00	
Warren Township—Total last report.....			6-1-12 2,000.....			Township.
Manistee County: Arcadia Township—Total last report.....	B	301.....	7,668.....	3,380 .224	\$1,600.00 112.00	County and township.
Arcadia Township.....	B	471.....		.268	6-28-11	Township.
Arcadia Township.....	B	672.....		.134	6-15-10	County.
Arcadia Township.....	B	1109.....	11,3-10	1,000.....	317.00	Township.
Arcadia Township.....	B	1929.....	6,29-12	1,364.....	7-15-10	County.
Arcadia Township.....	B	1930.....	6,29-12	1,176.....		Township.
Bear Lake Townships—Total last report.....	B			11,208	4,506	\$2,233.00
Bear Lake Townships.....	B	425.....	3,312.....	.776	\$383.00	County and Township.
Bear Lake Township.....	E	1117.....	11-10-10	1,008.....	500.00	Township.
Bear Lake Township.....	B	1636.....	10 13-11	.500.....		Township.
Brown Township—Total last report.....	B			4,820	1,776	\$888.00
Brown Township.....	B	712.....		4,561	3,570	\$1,785.00
Brown Township.....	B	1637.....	10-13-11	1,020.....	.991	486.00
Brown and Bear Lake Townshipa.....	B	1664.....	10 27-11	1,238.....	5,581	\$2,281.00
Cleon Township—Total last report.....	B	750.....	3,248.....	2,988	\$1,489.00	County.
Cleon Township.....	B	1129.....	12-3-10	2,000.....	.250	125.00
						County. County. Township.

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Cleon Township.....	B	1131	12-3-10	.724	County, Township, Township.
Cleon Township.....	B	1441	8-3-11	1.008	County, Township, Township.
Cleon Township.....	B	1518	8-18-11	1.004	.....	County, Township, Township.
Dickson Township—Total last report.....			7.994	3.248	\$1.624 00	County.
Filer Township—Total last report.....	B	454	.....	1.077	.....	County.
Filer Township.....	B	725	.....	4.908	2.352 .222 .512	County, County, County.
Filer Township.....					\$1.266 00 1110 256 00	8-9-10 8-9-10
Filer and Stronach Townships— Total last report.....			4.908	3.086	\$1.653 00	County.
Manistee Township—Total last report.....	B	665	8-6-10	.492	.....	County and township. Township.
Manistee Township.....	B	985	11-21-10	1.104	.....	County, County.
Manistee Township.....	B	1122	6-10-11	.440	.....	County, County.
Manistee Township.....	E	376	7-11-11	.440	440 00	County, County.
Manistee Township.....	B	1849	10-20-11	1.002	.....	County, County.
Manistee Township.....	B	1663	10-27-11	.446	.....	County, County.
Maple Grove Township—Total last report.....	B	738	.....	12.664	7.296	\$3.178 00 \$3.178 00
Maple Grove Township.....	B	1123	11-21-10	1.000	1.488 .490	250 00 245 00
Maple Grove Township.....	B	1232	6-10-11	.496	.496	8-9-10 8-9-10
Maple Grove Township.....	B	1648	10-20-11	.632	.....	5-24-12 5-24-12
Maple Grove Township.....				4.016	2.484	\$1.242 00
Marilla Township—Total last report.....	B	354	.....	3.144	1.144	County and township. Township.
Marilla Township.....	B	344	.....	.....	1.000	500 00 500 00
Marilla Township.....	B	1130	12-3-10	.632	1.000	5-24-12 5-24-12
Marilla Township.....	B	1419	7-24-11	.632	.632	Township.
Marilla Township.....	B	1421	7-26-11	1.008	1.008	County.
Marilla Township.....	B	1681	11-18-11	1.000	.....	County.
Marilla Township.....				6.692	4.684	\$2.342 00
Onekama Township—Total last report.....	B	404	.....	6.603	4.562	County, Township, Township.
Onekama Township.....	B	1116	11-10-10	.500	1.042	1-13-11 1-13-11
Onekama Township.....	B	1152	1-31-11	1.800	.....	County, County.
Onekama Township.....	B	1862	7-7-11	.500	.....	Township.
Onekama Township.....	B	1603	9-30-11	1.070	.....	County, County.
Onekama Township.....				9.473	6.804	\$2.802 00

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Date of application. Year and month.	Length. Applied for.	Built.	Reward paid.	Built by.	Date of payment.	Remarks.
Kalamazoo County. — Con.							
Pavilion Township—Total last report.	B 774	2 000	2 000	\$1,000 00		6-21-11	(County,
Pavilion Township.	B 1193	3 28 11	1 000	250 00		9-6-11	County,
Pavilion Township.	B 1262	5 17 11	1 020				County,
Pavilion Township.	B 1738	3 18 12	.500				County,
Portage Township—Total last report.	B 770	4 520	2 500	1,250 00			County,
Portage Township.	B 771	2 000	1 000	\$500 00		10-14-10	County,
Portage Township.	B 937	7 2 10	.568	500 00		8-4-10	County,
Portage Township.	B 1196	3 28 11	1 000	1,000 00			Township,
Portage Township.	B 1210	5 17 11	1 000	500 00		7-14-11	County,
Portage Township.	B 1754	3 18 12	1 000				County,
Portage Township.	B 1761	3 18 12	1 000				County,
Prairie Ronde Township—Total last report.	E 712	6 568	3 000	\$1,500 00			County,
Prairie Ronde Township.	B 1516	8 18 11	2 000	1 000	\$1,000 00	9-18-11	County,
Prairie Ronde Township.	B				327 00	10-24-11	County,
Richland Township—Total last report.	B 779	2 000	2 000	\$1,000 00		10-14-10	County,
Richland Township.	B 1162	2 23 11	.758	758 00		7-14-11	County,
Richland Township.	B 1163	2 23 11	1 242	500 00		9-6-11	County,
Richland Township.	B 1633	10 6 11	.250	250 00		1-18-12	Township,
Richland Township.	B 1638	10 6 11	.500	500 00		1-3-12	Township,
Richland Township.	B 1738	3 18 12	.500				County,
Ross Township—Total last report.	B 790	5 280	4 038	\$2,019 00			County,
Ross Township.	B 781						County,
Ross Township.	B 1169	2 23 11	2 000	1,736 00		9-6-11	County,
Ross Township.	B			96 00			County,

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Schoolecraft Township—Total last report.....	D	765	2,083	1,000	750.00	1-6-11
Schoolecraft Township.....	B	766	5-17-11	1,033	616.00	8-12-11	County.
Schoolecraft Township.....	B	1263	2,000	1,236	618.00	9-14-11	County.
Schoolecraft Township.....	B	1755	3-18-12	.500	.....	.....	County.
Schoolecraft Township.....	B	1760	3-18-12	.224	.....	.....	County.
Texas Township—Total last report.....	B	767	8-18-11	4,757	3,260	\$1,884.00	County.
Texas Township.....	A	1617	2,000	1,761	880.00	6-21-11	County.
Texas Township.....	A	1676	11-18-11	.500	.....	.....	County.
Texas Township—Total last report.....	E	761	.....	4,502	1,761	\$880.00	County.
Wakoshina Township—Total last report.....	E	1883	9-21-11	2,000	.994	\$894.00	County.
Wakoshina Township—Total last report.....	E	1889	6-1-11	3,156	3,156	\$2,578.00	9-18-11
Wakoshina Township.....	B	1875	7-11-11	.500	750	375.00	County.
Kalkaska County:				4,000	.994	\$894.00	County.
Boardman Township—Total last report.....	B	645	.....	5,527	4,008	\$2,004.00	7-15-10
Boardman Township.....	B	646	.....	.....	1,008	4.00	Township.
Boardman Township.....	B	753	.....	.....	1,000	500.00	Township.
Boardman Township.....	B	1008	8-15-10	1,000	511	255.00	6-18-12
Clearwater Township.....	B	1019	8-19-11	.500	500	500.00	County.
Clearwater Township.....	B	1520	8-19-11	.500	250	250.00	Township.
Clearwater Township.....	B	1646	10-19-11	.644	.644	322.00	3-18-12
Clearwater Township.....	E	1837	6-1-12	1,000	.....	.....	County.
Clearwater Township.....	B	1849	6-8-12	.498	.....	.....	Township.
Clearwater Township.....	B	1850	6-8-12	.172	.....	.....	Township.
Clearwater Township.....	B	1851	6-8-12	.308	.....	.....	Township.
Cold Springs Township—Total last report.....	B	1303	6-6-11	10,883	8,171	\$4,085.00	County.
Cold Springs Township.....	B	1856	6-8-12	1,058	1,058	\$529.00	9-27-11
Cold Springs Township.....	B	1836	6-1-12	.994	.....	.....	Township.
Excelsior Township—Total last report.....	B	.....	.....	3,064	1,058	\$529.00	County.
Cold Springs and Rapid River Township—Total last report.....	.....	.....	.....	1,008	1,008	\$504.00	County.
Excelsior Township—Total last report.....	.....	.....	.....	1,000	1,000	\$750.00	County.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
	Class.	Number of application.	Applied for.	Built.			
Kalkaska County—Con.							
Garfield Township—Total last report.....	B	1066	9-13-10	1,488 1,005	1,000	\$500.00	County and township.
Garfield Township.....				2,503	1,000	\$500.00	County.
Kalkaska Township.....	B	1647	10-20-11	.500	.....	.....	County.
Kalkaska Township.....	A	1682	11-18-11	.500	.....	.....	County.
Orange Township—Total last report.....				1,000	.....	.....	County.
Rapid River Township—Total last report.....	B	752	.....	3,002	1,500	\$750.00	County.
Rapid River Township.....	B	754	.....	1,000	500	500.00	County.
Rapid River Township.....				.498	248	248.00	County.
Springsfield Township—Total last report.....				3,002	2,988	\$1,498.00	County.
Wilson Township—Total last report.....				1,400	1,400	\$350.00	County.
Wilson Township—Total last report.....				2,218	2,218	\$1,109.00	County.
Kent County:							
Alpine Township.....	B	1292	6-2-11	1,000	1,000	\$500.00	6-28-11 District.
Bowne Township.....	B	1127	11-25-10	1,000	1,000	.....	Township.
Byron Township—Total last report.....				1,000	1,000	\$500.00	Township.
Grand Rapids Township—Total last report.....	B	346	.....	5,833	3,000	\$1,500.00	District.
Grand Rapids Township.....	B	630	.....	.....	.288	124.00	District.
Grand Rapids Township.....	B	915	.....	.....	.630	315.00	District.
Grand Rapids Township.....	B	916	.....	.....	.600	250.00	District.
Grand Rapids Township.....	B	1187	3-24-11	.994	.500	250.00	Township.
Grand Rapids Township.....	B	1190	3-24-11	.994	.....	.....	District.
Grand Rapids Township.....	B	1291	6-2-11	1,000	1,000	.....	District.
Grand Rapids Township.....	B	1335	10-2-11	1,000	1,000	845.00	10-4-11 District.
					10,501	5,948	\$2,984.00

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Lowell Township		B	1714	2-13-12	1,006			Township.
Paris Township—Total last report		B	1188	3-24-11	2,594	1,594	\$87 00	District.
Paris Township					1,000	1,000	500 00	District.
					3,594	2,594	\$1,297 00	
Plainfield Township—Total last report		B	598		2,000	1,010	\$605 00	District.
Plainfield Township		B	631			.500	250 00	District.
Plainfield Township		B	1186	3-23-11	1,080	.490	245 00	Township.
Plainfield Township		B	1188	3-24-11	531	.510	265 00	District.
					3,611	2,581	\$1,265 00	Township.
Sparta Township—Total last report		B	185		4,030	3,996	1,988 00	Township.
Sparta Township		B	1124	11-29-10	1,022	1,022	32 00	Township.
Sparta Township		B	1125	11-28-10	.510	.510	511 00	Township.
Sparta Township		B	1126	11-28-10	.510	.510	255 00	Township.
					6,102	6,102	\$3,051 00	Township.
Tyrone Township—Total last report		E	520	Extension.	11,438	10,002	86,000 00	Township.
Tyrone Township		E	824		.013	.013	\$13 00	Township.
Tyrone Township		E	825		.486	.486	496 00	Township.
Tyrone Township		B	1087	10-14-10	1,060	1,060	500 00	Township.
Tyrone Township		B	1492	8-10-11	.500	.482	530 00	District.
Tyrone Township		B	1483	8-10-11				Township.
					13,533	12,061	\$7,529 00	Township.
Walker Township—Total last report		B	1068	9-13-10	2,086	1,546	\$773 00	District.
Walker Township		B	1340	6-2-11	1,004	1,004	502 00	District.
Walker Township		B	1341	6-2-11	1,000	1,000	500 00	District.
					5,088	4,578	\$2,280 00	District.
Wyoming Township—Total last report		B	569	9-13-10	1,000	.480	\$245 00	Township.
Wyoming Township		B	1069	6-2-11	1,540	1,532	766 00	Township.
Wyoming Township		B	1558	9-6-11	2,026	1,028	514 00	Township.
					4,586	2,022	\$1,011 00	Township.
Keweenaw County:					2,002	2,002	\$2,002 00	Allottee Township—Total last report

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
	Applied for.	Built.				
Lake County:						
Ellsworth Township—Total last report.	B 920 1369 1610	..... 10 2-11 10 2-11	2 058 3 044 .974	1 050 1 000 .500	\$525 00 500 00 250 00	Township. Township. Township. Township.
Newkirk Township—Total last report.	B 1050 1353 1354 1352 1396	..... 6 2-10 6 29-11 6 29-11 6 29-11 7 17-11	2 000 1 016 1 004 2 040 .500	2 000 454 00 500 00 500 00 500	\$1,000 00 250 00 5 22-12 454 00 250 00	Township. Township. Township. Township. Township.
Lapeer County:						
Almont Township—Total last report.	B 361 866 867 868 1594 1703	..... ..... ..... ..... 9-20 11 1 4 12	4 535 484 726 379 1 125 .500	1 514 484 363 00 190 00 1 125 1 012 1 564	\$757 00 212 00 323 11 323 11 563 00 250 00 550 00	Township. Township. Township. Township. Township. Township. Township.
Imay Township—Total last report.	B 1318 1319 1638	..... 6 15-11 10 13-11	7 506 500 .500	4 908 500 .500	\$2,454 00 250 00 250 00	Township. Township. Township.
Mayfield Township	B 1621	10 5-11	2 840	4 728	\$2,385 00	Township.
North Branch Township—Total last report				1 306		Township.
Leelanau County:						
Bingham Township	B 1290	7 26-11	1 008			Township.
Empire Township	B 1840	8-28-11	2 010			Township.

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Lancaster County: Order Township—Total last report.		4.00	Township.....	Cancelled.
Tecumseh Township—Total last report.		2.000	Township.....	Cancelled.
Livingston County:				
Brighton Township.....	B	1980	6-14-12 1.000	Township.
Cohoctah Township.....	B	1567	9-7-11 .988	Township.
Conway Township.....	B	1287	5-28-11 .987	Township.
Deerfield Township.....	B	1882	6-18-12 1.000	Township.
Genoa Township.....	B	1697	12-11-11 1.076	Township.
Handy Township.....	B	1670	11-3-11 1.290	Township.
Hartland Township.....	B	1840	6-1-12 2.032	Township.
Howell Township—Total last report.	B	887	2.000	\$1,000.00
Howell Township.....	B	1121	11-15-10 6-21-10	2.000 .534
Howell Township.....	B	1338	6-21-11 6-21-11	.292 2.796
Howell Township.....	B	1337		
			7.380	4.584 \$2,292.00
Ioco Township.....	B	1694	12-5-11 6-1-12	Township.
Ioco Township.....	B	1839	1.044	Township.
			2.184	
Marion Township.....	B	1227	5-10-11 5-10-11	\$500.00
Marion Township.....	B	1228	5-10-11 12-22-11	1.000
Marion Township.....	B	1700		.152 .152
			2.132	1.132 \$566.00
Osecola Township.....	B	1217	5-10-11 4-22-12	1-3-12
Osecola Township.....	B	1794	5-10-11 6-24-12	Township.
Osecola Township.....	B	1836	1.012 1.114	Township.
Putnam Township.....	B	1231	5-10-11 6-1-12	1-3-12
Putnam Township.....	B	1838	2.000 3.000	Township.
			5.000	\$1,000.00
Unadilla Township.....	B	1833	6-15-12 3.000	Township.

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TABLE NO. 10.—Continued.

County and township.	Year. [Same]	Date of application. Number of suppliers.	Length. Applied for.	Reward paid. Built.	Date of payment. Built by.	Remarks.
Luce County: McMillian Township—Total last report.....	D 252	.....	1.240	.666 .333	\$500.00 250.00	County, County. 8-1-10
McMillian Township.....			1.240	.999	\$750.00	
Macomb County: Armenia Township.....	B 1843	6 1-12	1.074	.....	.....	Township.
Warren Township—Total last report.....		.....	2.000	2.000	\$2,000.00	Township.
Manistee County: Arcadia Township—Total last report.....	B 391	.....	7.688	3.380 .224	\$1,680.00 112.00	County and township. Township, County. 6 28-11
Arcadia Township.....	B 471	.....	.....	268	134.00	Township,
Arcadia Township.....	B 672	.....	.....	.634	317.00	Township, County, Township, Township, Township, Township, 7-15-10
Arcadia Township.....	B 1109	11.3-10	1.000	.....	.....	.....
Arcadia Township.....	B 1920	6.29	1.364	.....	.....	.....
Arcadia Township.....	B 1930	6.29-12	1.176	.....	.....	.....
Bear Lake Townships—Total last report.....		.....	11.208	4.506	\$2,233.00	County and Township.
Bear Lake Townships.....	B 425	.....	3.312	.776	.....	Township, County, County.
Bear Lake Township.....	E 1117	11-10-10	1.008	1.000	500.00	8-8-10
Bear Lake Township.....	B 1636	10 13-11	.500	.....	.....	.....
Brown Township—Total last report.....	B 712	.....	4.820	1.776	\$888.00	County and Township.
Brown Township.....	B 1637	10-13-11	1.020	.....	.....	County, County, County.
Brown and Bear Lake Townships.....	B 1864	10-27-11	1.238	.....	.....	County.
Cleon Township—Total last report.....	B 750	3.248	2.988	\$1,489.00	County, County, County, Township.
Cleon Township.....	B 1129	12-3-10	2.000	.250	125.00	8-9-10

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Cleon Township.....	B	131	12-3-10	.734	County, Township, Township.
Cleon Township.....	B	141	8-3-11	1.008	
Cleon Township.....	B	1518	8-18-11	1.004	.....
Dickson Township—Total last report.....			7.994	3.248	\$1,624.00	County.
Filer Township—Total last report.....	B	454	.....	1.077	.....	County.
Filer Township—Total last report.....	B	725	.....	4.908	2.352	County, County, County.
Filer Township.....			.....	.....	.222 .512	8-9-10 8-9-10
Filer and Strong Township—					256.00	
Total last report.....					\$1,653.00	
Manistee Township—Total last report.....	B	668	8-6-10	.482	.....	County and township.
Manistee Township.....	B	935	11-21-10	1.104	.....	Township, Township.
Manistee Township.....	B	1122	7-11-11	1.440	.....	County, County.
Manistee Township.....	E	1376	10-20-11	1.002	.....	County, County.
Manistee Township.....	B	1649	10-27-11	.446	.....	County, County.
Manistee Township.....	B	1653	.....	.....	.....
Maple Grove Township—Total last report.....	B	738	11-21-10	1.000	1.488	\$3,178.00
Maple Grove Township.....	B	1123	5-10-11	.496	.490	250.00
Maple Grove Township.....	B	1322	10-20-11	.496	.496	8-9-10
Maple Grove Township.....	B	1648	10-20-11	.532	.....	County, County.
Marilla Township—Total last report.....	B	354	12-3-10	.632	1.144	\$572.00
Marilla Township.....	B	744	7-24-11	1.008	1.000	10-27-10
Marilla Township.....	B	130	7-26-11	1.008	1.000	5-24-12
Marilla Township.....	B	1419	11-18-11	1.000	.632	286.00
Marilla Township.....	B	1431	.....	.....	504.00	5-24-12
Marilla Township.....	B	1681	.....	.....	.....	9-28-11
Marilla Township—Total last report.....					4.016	2,484
Marilla Township—Total last report.....						\$1,242.00
Onekama Township—Total last report.....	B	404	11-10-10	.500	6.692	4,884
Onekama Township.....	B	1116	1-31-11	1.042	5.603	\$2,342.00
Onekama Township.....	B	1152	7-7-11	1.800	4.662	2,281.00
Onekama Township.....	B	1362	9-30-11	1.070	1.042	1-13-11
Onekama Township.....	B	1603	.....	.....	621.00	
Onekama Township—Total last report.....					9.473	5,604
Onekama Township—Total last report.....						\$2,802.00

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Number of application.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
Manistee County—Con.								
Pleasanton Township—Total last report.....	B	1679	11-18-11	4,068 .838	2,508	\$1,254.00	County.	
Pleasanton Township.....					2,508	\$1,254.00	County.	
Springdale Township—Total last report.....	B	728	7-11-11	1,945	1,000	\$600.00	County.	
Springdale Township.....	B	1377	11-18-11	1,004	.995	498.00	County.	
Springdale Township.....	B	1690	11-18-11	.500	.500	.....	Township.	6-28-11
Springdale Township.....							County.	
Marquette County:								
Choceloy Township—Total last report.....	E	681	.....	3,806	1,806	\$1,906.00	County.	
Choceloy Township.....	E	888	.....	.....	194	194.00	County.	10-17-10
Choceloy Township.....	E	1369	7-7-11	161	1,806	1,806.00	County.	11-21-10
Choceloy Township.....	E	1370	7-7-11	1,000	161	161.00	County.	10-24-11
Choceloy Township.....					1,000	1,000.00	County.	10-24-11
Choceloy Township.....								
Macquie Township—Total last report.....					4,967	4,967	\$4,967.00	
Negaunee Township—Total last report.....					4,264	4,264	\$4,264.00	County.
Mason County:								
Amber Township—Total last report.....	E	991	8-1-10	2,488	1,500	\$1,375.00	County.	
Amber Township.....	E	1139	1-4-11	.783	1,042	.....	County.	
Amber Township.....	E	1140	1-4-11	1,287	.....	.....	County.	
Amber Township.....	E	1141	1-4-11	1,212	.....	.....	County.	
Amber Township.....	E	1142	1-6-11	1,136	.....	.....	County.	
Amber Township.....								
Amber and Victory Township.....	B	1889	6-19-12	7,958	1,500	\$1,375.00	County.	
Custer Township—Total last report.....	B	1905	6-25-12	1,500	2,056	\$2,056.00	County.	
Custer Township—Custer Township.....	B			3,560	2,056	\$2,056.00	County.	

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Custer and Amber Township—Total last report.....		1,500	1,500	\$1,500.00	County.
Custer, Eden and Riverton Townships—					
Total last report.....		1,480	.500	\$250.00	County.
Custer and Riverton Townships—					
Total last report.....		2,248	2,248	\$1,624.00	County.
Eden Township.....	B B	1887 1888	11-21-11 11-21-11	.500 .500	\$250.00
Eden Township.....	B	1884	6-15-12	.910	\$250.00
Freeoil Township.....	B	1885	2,070		\$250.00
Freeoil Township.....	B	1887	6-27-12	2,012	
Freeoil Township—Total last report.....			1,006	1,000	\$500.00
Freeoil Township.....	B	746		1,006	
Freeoil Township.....	B	1884		1,006	
Freeoil Township.....	B	1885		1,006	
Freeoil Township.....	B	1887		1,006	
Grant Township—Total last report.....			5,968	1,006	\$503.00
Grant Township.....	B	721		3,001	
Grant Township.....	B	1880	8-19-10	1,000	\$1,000.00
Grant Township.....	B	1881	8-19-10	.506	\$500.00
Grant Township.....	B	1888	6-8-12	1,000	\$500.00
Grant Township.....	B	1900	6-25-12	.014	\$500.00
Grant Township.....	B			.706	
Grant Township—Total last report.....			6,227	4,506	\$2,233.00
Pere Marquette Township—Total last report.....			4,215	2,355	\$2,355.00
Pere Marquette Township.....	E	935		1,157	\$1,157.00
Pere Marquette Township.....	E	947	7-12-10	1,122	
Pere Marquette Township.....	E	990	8-1-10	.429	
Pere Marquette Township.....	E	1143	1-9-11	.888	
Pere Marquette Township.....	E	1146	1-18-11	1,048	
Pere Marquette Township.....	B			7,682	
Pere Marquette Township—Total last report.....			7,682	3,941	\$3,941.00
Riverton Township—Total last report.....			1,903	.500	\$500.00
Riverton Township.....	B	1407	7-19-11	15,002	
Riverton Township.....	B	1901	6-25-12	1,994	
Riverton and Custer Township.....	B	1886	6-19-12	1,984	
Riverton Township—Total last report.....			1,500	1,000	\$250.00
Sheridan Township—Total last report.....					County.
Sheridan Township.....	B	1147	1-24-11	.478	\$239.00
Sheridan Township.....	B	1887	6-19-12	2,010	
Sheridan Township.....	B	1902	6-25-12	2,010	
Sheridan Township.....	B	1928	6-27-12	1,054	
				5,552	\$239.00
				.478	

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TABLE NO. 10.—*Continued.*

County and township.	Case	Number of application.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
				Applied for.	Built.			
Iason County.—Con. Summit Township—	B	1006	6-25-12	3.002				
Victory and Sherman Townships— Total last report.	B	280		.991	.900 .491	\$500.00 245.00	6-14-11	County.
Victory and Sherman Townships—	B			.991	.901	\$745.00		County.
Decosta County: Aetna Township—	B	1694	7-15-11	1.118	1.118	\$559.00	11-1-11	County.
Aetna Township—	B	1694	10-26-11	.128	.128	64.00	5-24-12	County.
Austin Township— Austin Township—	B	1297	6-6-11	1.004	1.004	\$502.00	9-22-11	County.
Austin Township—	B	1311	6-12-11	1.000	1.000	500.00	9-18-11	Township.
Austin Township—	B	1810	5-22-12	.502				
Big Rapids Township—	B	963	7-25-10	.998	.998	\$1,002.00	8-1-11	County.
Coffax Township—Total last report.	B	718		4.179				
Coffax Township—	B	1391	7-15-11	1.136	3.042	\$1,521.00	7-14-11	County.
Coffax Township—				5.315	3.042	\$1,521.00		County.
Deerfield Township—Total last report.	B	484		1.018	1.018	\$509.00	1-7-11	County.
Deerfield Township—				1.018	1.018	\$509.00		County.
Fork Township—Total last report.	B	1392	7-15-11	1.004	1.004	\$502.00		County.
Fork Township—				2.004	1.004	\$502.00		County.
Grant Township—	B	1877	6-15-12	.600				Township.
Grant Township—	B	1878	6-15-12	.600				Township.
				1.000				

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Hinton Township—Total last report.....	B	1003	8-11-10	1,000	1,000	\$500 00	Township.
Hinton Township.....	B	1046	8-28-10	1,000	1,000	500 00	Township.
Hinton Township.....	B	1296	6-6-11	1,000	1,000	500 00	Township.
Hinton Township.....	B	1296	7-14-11	.500	.500	.....	County.
Hinton Township.....	B	1388	7-14-11	.500	.500	.....	Township.
Hinton Township.....	B	1389	7-14-11	.500	.500	.....	Township.
Hinton Township.....	B	1390	7-14-11	5,500	2,000	\$1,000 00	Township.
Mecosta Township.....	B	968	7-25-10	1,000	1,000	\$500 00	County.
Mecosta Township.....	B	1022	10-6-11	.500	.500	.....	County.
Millbrook Township—Total last report.....	B	383	.....	1,048	1,048	524 00	County.
Millbrook Township.....	B	1024	6-27-12	1,136	1,136	524 00	County.
Morton Township—Total last report.....	B	159	.....	5,988	3,018	\$1,509 00	County and township.
Morton Township.....	B	1144	1-11-11	246	246	123 00	Township.
Morton Township.....	B	1145	1-11-11	.984	.984	492 00	Township.
Morton Township.....	B	1286	4-22-12	1,002	1,002	11-17-11	County.
Morton Township.....	B	1811	5-22-12	.494	.494	.....	Township.
Morton Township.....	B	1812	5-22-12	1,028	1,028	.....	Township.
Morton Township.....	B	1813	5-22-12	.512	.512	.....	Township.
Sheridan Township—Total last report.....	B	1283	5-26-12	1,072	1,072	\$3,124 00	County and township.
Sheridan Township.....	B	1888	6-19-12	.986	.986	.....	Township.
Wheatland Township—Total last report.....	B	628	.....	3,974	3,974	\$1,985 00	County and township.
Wheatland Township.....	B	1044	8-25-10	1,986	1,986	10-27-10	Township.
Wheatland Township.....	B	1045	8-25-10	.500	.500	12-7-11	Township.
Wheatland Township.....	B	1286	5-29-11	.492	.492	250 00	Township.
Wheatland Township.....	B	1383	7-15-11	1,006	1,006	246 00	Township.
Wheatland Township.....	B	1823	5-27-12	1,000	1,000	.....	County.
Menominee County, Ingallston Township—Total last report.....	C	1156	2-13-11	2,468	2,468	\$1,500 00	County and township.
Ingallston Township.....	E	1156	2-13-11	3,340	2,000	1,500 00	County.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Date of application.	Length.	Reward paid.	Built by.	Remarks.
Number of applications.		Applied for.	Built.			
Menominee County.—Con. Mellen Township—Total last report.			5,073			County.
Menominee Township—Total last report.	C	504	11,821	7,538	\$6,544 00	County.
Menominee Township.....	C	688	.....	.971	729 00	County.
Menominee Township.....	C	719	.....	1,220	922 00	County.
Menominee Township.....	B	555	7-18-10	1,000	750 00	County.
				1,000	500 00	7-14-11 8-8-11
Menominee and Ingallston Townships— Total last report.			12,891	11,758	\$9,444 00	County.
Menominee and Mellen Townships— Total last report.			.....	1,524	1,524	County.
Meyer Township.....	C	1049	9-1 10	1,000	1,000	County.
Nadeau Township—Total last report.			.....	2,662	1,000	County.
Spaulding Township—Total last report.			.....	1,625	1,625	County.
Stephenson Township—Total last report.			5,500	3,500	\$1,750 00	County and township.
Stephenson Township.....	B	869	.....	1,000	500 00	1-7-11
Stephenson Township.....	B	870	.....	1,000	500 00	Township.
Stephenson Township.....	B	1344	6-28 11	1,000	500	1-7-11
Stephenson Township.....	B	1345	6-28 11	1,079	539 00	Township.
						8-24-12 8-24-12
Midland County:			7,579	7,079	\$3,539 00	
Jasper Township—Total last report.	B	1,322	8 25 11	1,500	1,500	Township.
Jasper Township.....	B	1,798	5-7 12	1,960	980 00	Township.
Jasper Township.....	B	1,197	5-7 12	1,000	.....	Township.
				.500	.....	Township.
Milwaukee County:			4,980	3,460	\$1,730 00	
Caldwell Township.....	B	1705	1-19-12	1,000	County.

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Forest Township Forest Township.....	B B	1706 1778	1-19-12 3-9-12	1,000 1,026	County. Township.
Lake Township Total last report.....						Township. Township.
Lake Township.....	C	1702	1-2-12	1,000	.....	Township. Township.
Pioneer Township Pioneer Township.....	B B	943 1409	7-8-10 7-2-11	1,017 1,988	1,017 1,017	\$500 00 \$500 00
Pioneer Township.....						10-9-11 Township. Township.
Reefer Township.....	B C B B	1074 1889 1716 1715	9-15-10 11-28-11 2-20-12 2-20-12	1,004 .992 .990 1,000	1,017 .995 .990 1,000	\$500 00 \$502 00 \$444 00 \$495 00
Reefer Township.....						9-25-11 Township. Township. Township. Township.
Reefer Township.....						7-14-11 Township. Township. Township.
Source County: Ash Township—Total last report.....				1,000	.....	Township.....
Bedford Township—Total last report.....	E	399		7,000	\$7,000 00	Township.....
Bedford Township—Total last report.....	E	1220	6-10-11	2,396	2,396 00	Township.....
Bedford Township—Total last report.....						7-14-11 Township. Township. Township.
Erie Township—Total last report.....						Township.....
Erie Township—Total last report.....	E	932		11,900	9,396	\$9,396 00
Erie Township—Total last report.....						Township.....
Erie Township—Total last report.....	E	932		6,553		
Erie Township—Total last report.....						Township.....
Erie Township—Total last report.....	E	1707 1708	1-22-12 1-22-12	10,061 10,061	5,000 5,000	\$5,000 00
Erie Township—Total last report.....						Township.....
Monroe Township—Total last report.....				1,000	.....	Township.....
Whitedford Township.....	E	1707	1-22-12	3,996	3,996	3,996
Whitedford Township.....	E	1708	1-22-12	3,996	3,996	3,996
Monroe County:						
Belvidere Township.....	B B B	942 1335 1635	7-8-10 6-23-11 10-13-11	.990 1,980 .076	.990 1,980 .076	\$495 00 \$950 00 \$1,475 00
Belvidere Township.....						9-30-10 Township. Township. Township.
Belvidere Township.....						4-20-12 Township. Township.

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TABLE NO. 10.—Continued.

County and township.	Year Number of applicants	Date of application.	Length. Applied for.	Reward paid. Built.	Date of payment.	Built by.	Remarks.
Montcalm County,—Con.							
Cato Township.....	B	1874	7-11-11	1,000	1,000	\$300.00	12-1-11 Township.
Cato Township—Total last report.....	B	1003	8-11-10	1,000	1,000	\$300.00	Township.
Cato Township.....	B	1885	12-7-10	2,028	2,028	500.00	1-7-11 Township.
Cato Township.....	B	1883	6-29-12	304	304	1,014.00	6-21-12 Township.
Cato Township.....	B	1884	6-29-12	360	360	.....	Township.
Day Township—Total last report.....	B	1890	5-11-12	1,000	1,000	\$300.00	Township.
Day Township.....	B	1892	5-14-12	.984	.984	.....	Township.
Day Township.....	B	1893	5-14-12	.750	.750	.....	Township.
Day Township.....	B	1894	5-14-12	.788	.788	.....	Township.
Douglas Township—Total last report.....	B	1885	8-22-11	4,972	1,000	\$300.00	.....
Douglas Township—Douglas Township.....	B	1885	8-22-11	1,650	1,650	\$825.00	5-16-12 Township.
				2,018	1,000	500.00	Township.
				3,668	2,650	\$1,325.00	.....
Douglas and Sidney Townships—				2,500	2,500	\$1,250.00	Stanton Good Roads Ass'n.
Total last report.....							
Eureka Township.....	B	1888	9-19-11	3,194	3,194	.....	Township.
Eureka Township.....	B	1889	9-19-11	2,020	2,020	.....	Township.
Eureka Township.....	B	1890	9-19-11	1,972	1,972	\$506.00	3-1-12 Township.
Eureka Township.....	B	1891	9-19-11	1,012	1,012	.....	Township.
Eureka Township.....	B	1892	9-19-11	2,044	2,044	.....	Township.
				10,246	1,012	\$506.00	.....
Evergreen Township.....	B	1710	2-1-12	1,230	1,230	.056	5-16-12 Stanton Good Roads Ass'n.
Ferry Township—Total last report.....	B	861987	.987	498.00	11-21-10 Township.
Ferry Township.....	B997	.997	\$498.00

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Montealm Township.....	B	1238	5-10-11	2,008					Township.
Reynolds Township Total last report.....	B	911	4,383	3 145	\$1,238 00			Township.
Reynolds Township.....	B	1137	1-3-11	1,318	1,748	874 00			Township.
Reynolds Township.....	B	1606	8 16-11	1,730	1,730	659 00			Township.
Reynolds Township.....	B	1662	.....	7,941	7,941	865 00			Township.
Richland Township.....	B	1711	2 1-12	1,280	1,260	634 00			Township.
Sidney Township.....	B	556	.....	.....	.....	630 00			Stanton Good Roads Ass'n.
Muskegon County:									
Casnovia Township—Total last report.....	B	443	.....	5,498	4,000	\$2,250 00			County and township.
Casnovia Township.....	B	544	.....	.....	500	250 00			Township.
Casnovia Township.....	E	645	.....	.....	496	248 00			Township.
Casnovia Township.....	B	1173	3-11-11	1,000	1,000	502 00			Township.
Casnovia Township.....	B	1204	4-4-11	990	998	500 00			County.
Casnovia Township.....	B	1205	4-4-11	998	998	500 00			Township.
Casnovia Township.....	B	1831	5 31-12	1,008	.....	.....			Township.
Casnovia Township.....	B	1730	.....	9,494	6,498	3,750 00			
Cedar Creek Township Total last report.....	E	556	.....	2,052	2,052	\$2,052 00			County.
Cedar Creek Township.....	E	556	.....	2,052	2,052	\$2,052 00			County.
Dalton Township Total last report.....	E	910	.....	3,000	1,000	\$1,000 00			County.
Dalton Township.....	E	904	8 6-10	630	1,500	1,500 00			County.
Dalton Township.....	E	1047	9 12-10	1,510	1,510	630 00			County.
Dalton Township.....	E	1738	3 6-12	990	1,510	1,510 00			County.
Dalton Township.....	E	1730	.....	6,139	4,640	34,649 00			County.
Eccleston Township Total last report.....	B	1730	3 5-12	2,385	2,385	\$2,385 00			County.
Eccleston Township.....	B	1730	.....	3,385	2,385	\$2,385 00			County.
Fruitland Township.....	E	1607	10 5 11	1,302	1,302	\$1,302 00			County.
Fruitland Township.....	E	557	.....	2,020	1,015	\$1,015 00			County.
Fruitport Township Total last report.....	E	729	.....	1,005	1,005	727 11			County.
Fruitport Township.....	E	1114	3 11-11	281	281	1,005 00			County.
Fruitport Township.....	B	1735	3 5-12	1,010	1,010	281 00			County.
				3,311	2,301	\$2,301 00			

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Number of application.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
				Applied for.	Built.			
Muskegon County.—Com. Halton Township—Total last report.....	E	1736	3-5-12	2.005 .560	\$2,005 00			County; County;
Laketon Township.....	E	1048	9-12 10	1.071 2.505	\$2,005 00			County;
Montague Township—Total last report.....	E			1.033	\$1,033 00			County;
Moorland Township.....	A B	1175 1737	3-11 11 3-5 12	1.016 2.030	\$254 00			County; County;
Muskegon Township Total last report.....	E	1378		1.187	\$1,187 00			County;
Muskegon Township.....	E	1598	7-11 11 9-23-11	1.634	.968	\$1,968 00		County;
Muskegon and Ezeleton Townships— Total last report.....				3.729	2.035	\$2,035 00		County;
Muskegon and Laketon Townships— Total last report.....					2.031	\$2,031 00		County;
Norton Township—Total last report.....	E	1381		.322	.322	\$322 00		County;
Norton Township.....	E	1432	7-13 11	2.930	\$2,930 00			County and township.
Norton Township.....	E	1821	7-26-11 5-27 12	1.012 .170	1.012	\$284 00 1,012 00		Township.
Norton Township.....	E			4.396	4.226	\$4,226 00		County;
Norton and Fruitport Townships— Total last report.....	E	664		1.893	1.161	\$1,161 00		County;
Norton and Fruitport Townships.....	E				.733	.733 00		County;
Ravenna Township.....	B	1136	1-3 11	1.894	1.894	\$1,894 00		Township.
Ravenna Township.....	B	1214	4-19-11	.986				County;
Ravenna Township.....	B	1769	4-3-12	3.227 .474	1.808	\$904 00	6-28-11	Township. County; Township.

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FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Date	Length.		Reward paid.	Date of payment.	Built by.	Remarks.
		Date of application.	Applied for.				
Muskegon County—Con.							
Gardell Township.....	B 1346	6-28-11	1,000				Township.
Gardell Township.....	B 1347	6-28-11	.900				Township.
			1,500				
Grant Township—Total last report.....			3,978	\$448.00	9-30-10	Township.	
Grant Township.....	B 704			.905	409.00	10-19-10	Township.
Grant Township.....	B 705			.906	409.00	10-4-11	Township.
Grant Township.....	B 707			1.008	504.00	9-7-11	Township.
Grant Township.....	B 1321	6-18-11	1,014	1.014	507.00		
			4,982	4,982	\$2,496.00		
Sheridan Township—Total last report.....			5,475				Township.
Sheridan Township.....	E 1460			2,500	\$2,500.00	11-17-11	Township.
Sheridan Township.....	E 1172	3-6-11	.374	.374	469.00	1-7-11	Township.
Sheridan Township.....	E 1579	9-15-11	1,000	1,000	1,000.00	10-4-11	Township.
Sheridan Township.....	E 1580	9-15-11	.492	.492	492.00	11-17-11	Township.
			7,341	4,366	\$4,366.00		
Oakland County:							
Avon Township—Total last report.....			5,333	3,896	\$1,948.00		
Avon Township.....	B 882			.937	469.00	1-7-11	Township.
Avon Township.....	B 1020	8-18-10	.812	.812	406.00	1-7-11	Township.
Avon Township.....	B 1276	5-23-11	.549				
Avon Township.....	B 1356	6-30-11	1,092	1,092	546.00	6-20-12	Township.
Avon Township.....	B 1605	9-30-11	.240				
			8,026	6,737	\$3,369.00		
Bloomfield Township—Total last report.....			4,652	3,330	\$1,665.00		
Bloomfield Township.....	B 13			.570	285.00	1-11-11	Township.
Bloomfield Township.....	B 265			.250	125.00	1-7-11	Township.
Bloomfield Township.....	B 751			.502	251.00	1-7-11	Township.
Bloomfield Township.....	B 1184	3-20-11	2,004	2,004	2,004.00	6-20-12	Township.
			6,656	6,656	\$4,330.00		

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Farmington Township.....	B	17	7-19-10	1,136	.642	\$321.00	10-31-10	Township.....	Reopened.
Farmington Township.....	B	828	7-2-10	2,064	2,064	1,032.00	10-0-11	Township.....	
Farmington Township.....	B	1233	7-21-11	.500	.500	250.00	10-0-11	Township.....	
Holly Township.....	B	1418	7-22-11	1,000	1,000	\$1,003.00	6-26-12	Township.....	
Milford Township.....	B	1876	6-15-12	2,134	2,134	\$500.00	6-26-12	Township.....	
Oakland Township.....	B	1416	7-20-11	2,054	1,000	\$500.00	6-26-12	Township.....	
Oakland Township.....	B	1822	5-27-12	1,942	1,942	.....	.....	Township.....	
Pontiac Township—Total last report.	B	892	7-14-11	918	2,000	\$1,000.00	.....	Township.....	
Pontiac Township.....	B	1885	7-14-11	2,010	2,010	.....	.....	Township.....	
Pontiac Township.....	B	1886	7-14-11	1,844	1,844	.....	.....	Township.....	
Pontiac Township.....	B	1887	7-14-11	6,572	2,000	\$1,000.00	.....	Township.....	
Royal Oak Township.....	C	1456	8-3-11	2,226	2,226	.....	.....	Township.....	
Royal Oak Township.....	C	1457	8-3-11	1,428	1,428	.....	.....	Township.....	
Oceana County:				3,665	.....	.....	.....
Reopen Township—Total last report.	E	890	5-22-12	3,537	1,788	\$1,788.00	1-7-11	Township.....	
Beaumont Township.....	E	1807	5-22-12	1,250	1,116	1,116.00	.....	Township.....	
Elbridge Township.....	E	1241	5-10-11	.988	.988	\$988.00	1-8-12	Township.....	
Elbridge Township.....	E	1295	6-6-11	1,004	.841	341.00	1-8-12	Township.....	
Elbridge Township.....	E	1891	6-21-12	.998	.....	.....	.....	Township.....	
Elbridge Township.....	E	1892	6-21-12	1,003	.....	.....	.....	Township.....	
Ferry Township—Total last report.	B	803	8-18-10	3,694	2,556	\$1,278.00	10-28-10	Township.....	
Ferry Township.....	B	1025	8-18-10	.516	.516	259.00	8-8-11	Township.....	
Ferry Township.....	B	1026	8-18-10	.587	.587	294.00	8-8-11	Township.....	
Ferry Township.....	B	1821	5-5-12	1,216	1,216	.....	.....	Township.....	
Golden Township—Total last report.	E	731	Extension.....	4,079	2,004	\$2,004.00	9-16-10	Township.....	
Golden Township—Total last report.	E	732	.....	.011	1,051	1,051.00	9-12-11	Township.....	

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—*Continued.*

County and township.	Class.	No. number of application.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
				Applied for.	Built.			
Oceana County—Con.								
Golden Township—Con.								
Golden Township.....	E	1100	10-17-10	1,000	1,000	\$1,000 00	7-14-11	Township.
Golden Township.....	E	1236	4-5-11	1,306	.....	.....	.....	Township.
Golden Township.....	E	1691	12-1-11	1,000	.....	.....	.....	Township.
Grant Township—Total last report.....					7,396	5,090 00	.....	.....
Greenvwood Township—Total last report.....					1,003	.....	.....	.....
Greenvwood Township—Total last report.....	B	377	.....	1,000	.....	.....	.....	.....
Greenvwood Township—Total last report.....	B	378	.....	.....	.....	.....	.....	.....
Hart Township—Total last report.....					1,000	250 00	11-21-10	Township.
Hart Township—Total last report.....	E	1413	7-21-11	3,802	1,892	\$1,892 00	11-21-10	Township.
Hart Township—Total last report.....	E	1602	9-30-11	2,002	1,748	1,748 00	12-15-11	Township.
Hart Township—Total last report.....	E	1857	6-8-12	1,386	1,232	1,232 00	12-15-11	Township.
Hart Township—Total last report.....	E	1857	6-8-12	.764	.....	.....	.....	Township.
Newfield Township—Total last report.....					8 644	4,832 00	.....	.....
Pentwater Township—Total last report.....					3,248	2,000	.....	.....
Shelby Township—Total last report.....					1,000	1,000	.....	.....
Shelby Township—Total last report.....	E	654	.....	10,887	9,357	\$0,357 00	.....	.....
Shelby Township—Total last report.....	E	724	.....	.....	.462	492 00	7-15-10	Township.
Shelby Township—Total last report.....	E	1058	9-9-10	2,256	1,008	1,008 00	9-8-10	Township.
Shelby Township—Total last report.....	E	1652	10-20-11	1,000	.236	2,236 00	1-5-12	Township.
Shelby Township—Total last report.....	E	1653	10-20-11	1,418	.500	.500 00	1-6-12	Township.
Shelby Township—Total last report.....	E	1655	1-3-12	1,002	.....	.....	.....	Township.
Weare Township—Total last report.....					16 533	13,613	\$13,613 00	.....
Weare Township—Total last report.....	E	458	.....	2,000	.....	.....	.....	.....
Weare Township—Total last report.....	E	1250	5-16-11	.....	.....	.....	.....	.....
Weare Township—Total last report.....	E	1709	2-1-12	.....	.....	.....	.....	.....
Weare Township—Total last report.....	E	458	.....	2,000	.....	.....	.....	.....
Weare Township—Total last report.....	E	1250	5-16-11	.....	.....	.....	.....	.....
Weare Township—Total last report.....	E	1709	2-1-12	.....	.....	.....	.....	.....

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class.	Number of application.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
				Applied for.	Built.			
Oceola County—Con.								
Richmond Township—Total last report.	B	807		2,000	1,000	\$500 00	10-31-10	Township.
Richmond Township.	B	808		.....	1,000	500 00	10-4-10	Township.
Richmond Township.	B	1525	8-25-11	1,004	.....	.....	.....	Township.
Richmond Township.	B	1604	9-30-11	1,000	.....	.....	.....	Township.
Ottawa County:								
Chester Township—Total last report.	B	948	7-12-10	2,000	2,000	\$1,000 00	1-7-11	Township.
Chester Township.	B	949	7-12-10	1,326	1,326	663 00	1-7-11	Township.
Chester Township.	B	950	7-12-10	250	250	.....	.....	Township.
Chester Township.	B	1487	8-10-11	506	506	253 00	1-7-11	Township.
Chester Township.	B	.....	.....	2,004	.....	.....	.....	Township.
Preque Isle County:								
Posen Township—Total last report.				6,086	3,832	\$1,916 00	.....	.....
Recommon County:								
Higgins Township—Total last report.	B	460		4,490	2,000	\$1,000 00	12-15-11	Township.
Higgins Township.	B	487		.....	490	245 00	1-27-10	Township.
Higgins Township.	B	1793	5-11-12	1,028	2,000	1,000 00	.....	Township.
Higgins Township.	B	.....	.....	5,518	4,490	\$2,245 00	.....	.....
Saginaw County:								
Albee Township.	E	1606	9-30-11	3,026	.....	.....	.....	County.
Birch Run Township—Total last report.				3,632	3,632	\$3,632 00	.....	County.
Blumfield Township—Total last report.	E	855		3,300	2,020	\$2,020 00	7-14-11	County.
Blumfield Township.	E	875		.....	1,029	1,020 00	8-9-10	County.
Blumfield Township.	E	953	7-18-10	1,000	1,751	751 00	10-4-10	County.
Blumfield Township.	E	957		.....	1,000	1,000 00	8-9-10	County.
Blumfield Township.	E	1576	9-9-11	1,000	247	247 00	10-2-11	County.
Blumfield Township.	E	1,000	144	644 00
				6,047	5,691	\$5,691 00

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									Township and county.
Brady Township—Total last report.....	E	962	7-18 10	2,486	.977	\$977.00	1,002	10-2-11	County.
Brady Township.....	E			3,468	1,979	\$1,979.00			
Bridgeport Township—Total last report.....	E	877	7-28-10	7,194	2,193	\$2,193.00	1,088	7-14-11	County.
Bridgeport Township.....	E	657	7-28-10	.632	.632	\$.632.00	1,088	11-1-10	County.
Bridgeport Township.....	E	659	7-28-10	1,917	.....	.....	.....	.....	County.
Bridgeport and Spaulding Townships—Total last report.....	E			0.743	3,913	\$3,913.00			
Buena Vista Township—Total last report.....	E	290	.....	5,268	5,268	\$5,268.00			County.
Buena Vista Township.....	E		11,120	9,529	\$9,529.00	417	7-15-10	County.	
Buena Vista Township.....	E	876	.....	690	690	690.00	690	7-14-11	County.
Buena Vista Township.....	E	961	7-18-10	2,483	2,483	2,483.00	2,483	7-14-11	County.
Carrollton Township—Total last report.....	E	1038	8-26-10	1,138	2,260	\$1,427.00	333	10-4-10	County.
Carrollton Township.....	E			3,398	2,563	\$1,760.00			
Carrollton and Kochville Townships—Total last report.....	E .....			.493	.493	\$493.00			County.
Cheesaning Township—Total last report.....	C	1450	8-4-11	2,490	2,490	\$2,490.00	1,532	1,142	Township.
Cheesaning Township.....	C			1,532	1,532	1,532.00			County.
Frankenmuth Township—Total last report.....	E	963	.....	4,021	4,021	\$3,641.00			County.
Frankenmuth Township.....	E			4,021	4,021	4,021.00			County.
James Township—Total last report.....	E	837	.....	4,691	3,017	\$3,017.00	1,674	8-9-10	County.
James Township.....	E			1,674	1,674	1,674.00			County.
Jonesfield Township—Total last report.....	E	287	.....	3,025	3,025	\$3,025.00			County and township.
Jonesfield Township.....	E	1075	9-16-10	.505	.505	\$.505.00			Township.
Jonesfield Township.....	E	B	.....	7,974	5,494	\$5,241.00			County.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Class	Date of application. Number of application.	Length. Applied for.	Reward Paid. Built.	Date of payment. Built by.	Remarks.
Saginaw County.—Con-						
Kochville Township—Total last report.....	E	1553	6,036	4,037	\$4,037.00	County.
Kochville Township.....	E	1554	.....	994	994.00	County.
Kochville Township.....	E	.....	397	397	397.00	County.
Maple Grove Township—Total last report.....	C	1414	7-20-11	5,110	5,128	County.
Maple Grove Township.....	.....	.....	7,998	2,888	\$2,888.00	County.
Richland Township—Total last report.....	E	856	.....	3,970	1,492	County.
Richland Township.....	E	1449	8-4-11	1,080	1,085	County.
Richland Township.....	.....	.....	3,980	2,000	2,000.00	County.
Saginaw Township—Total last report.....	E	1336	.....	7,965	5,477	County.
Saginaw Township.....	E	1039	8-26-10	421	500	County.
Saginaw Township.....	E	1415	7-20-11	588	521	County.
Saginaw Township.....	E	1828	6-29-12	2,080	588	County.
Saginaw Township—Total last report.....	E	1450	.....	9,045	6,510	County.
Saginaw and Buena Vista Township—						
Total last report.....	.....	.....	2,000	2,000	\$2,000.00	County.
Spaulding Township—Total last report.....	E	960	7-18-10	1,494	\$1,494.00	County.
Spaulding Township.....	E	1451	8-4-11	1,943	1,943.00	County.
Spaulding Township.....	.....	.....	1,969	1,900	1,900.00	County.
St. Charles Township—Total last report.....	B	1533	.....	4,426	3,937	Township.
St. Charles Township.....	B	1534	8-25-11	1,500	1,500	County.
St. Charles Township.....	8-25-11	500	500	500	County.
					2,602	Rejected.

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Taymouth Township—Total last report.....		.502	.502	\$502 00	County.
Thomastown Township—Total last report.....		4.478	4.441	\$4,441 00	County.
Zilwaukee Township.....	B 1076	9-16-10	.183		County.
St. Clair County:					
Brockway Township—Total last report.....			1.516		Township.
East China Township—Total last report.....			2.224	1,038	Township.
East China Township.....	B 457			1.186	Township.
Kimball Township—Total last report.....			2.224	2.224	Township.
Kimball Township.....	E 621			1.039	Township.
Kimball Township.....	E 652			1.389	Township.
Kimball Township.....	E 652			1.389	Township.
Port Huron Township—Total last report.....			10.197	.989	Township.
Port Huron Township.....	E 142			1.164	Township.
Port Huron Township.....	E 382			1.288	Township.
Port Huron Township.....	E 386			1.609	Township.
Port Huron Township.....	E 678			0.19	Township.
Port Huron Township.....	E 723			.500	Township.
Port Huron Township.....	E 1090			.500	Township.
Port Huron Township.....	E 1110			.243	Township.
Port Huron Township.....	E 1651			.286	Township.
Port Huron Township.....	E 1935			.324	Township.
Port Huron Township.....	E 6	23-12		.679	Township.
Port Huron Township.....	E 970			.679	Township.
St. Joseph County:					
Burr Oak Township.....	B 1624	10-6-11	1.000		Township.
Constantine Township.....	A 1537	8-26-11	1.000	\$250 00	Township.
Florence Township.....	B 1062	9-12-10	1.004		Township.
Sanilac County:					
Custer Township.....	B 1903	6-25-12	5.800		Township.
Custer Township.....	C 1903	6-25-12	2.000		Township.
Greenleaf Township.....	B 983	7-30-10	7.800		Township.
Greenleaf Township.....	B 984	7-30-10	9.96	\$483 00	Township.
Greenleaf Township.....	B 1211	4-19-11	9.96	464 00	Township.
Greenleaf Township.....	B 1212	4-19-11	1.007	568 00	Township.
Greenleaf Township.....			1.000	560 00	Township.
			3.901	\$1,850 00	

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TABLE NO. 10.—Continued.

County and township.	Class.	Number of application.	Date of application.	Length. Applied for.	Built. Built.	Reward paid.	Date of payment.	Built by.	Remarks.
<i>Sanilac County—Con.</i>									
Lexington Township—Total last report.				1,000	1,000	\$1,000.00		Township.	
Mariette Township.....	B	996	8-6-10	1,004	1,004	\$502.00	10-4-10	Township.	
Mariette Township.....	B	1615	10-4-11	1,004	1,004	\$502.00	10-4-11	Township.	
Mariette Township.....	B	1616	10-4-11	1,000	1,000	\$500.00	10-4-11	Township.	
Moore Township—Total last report.				3,008	3,008	\$1,504.00		Township.	
Moore Township.....	B	1596	8-25-11	2,000	2,000			Township.	
Moore Township.....	E	818	1,004	3,004	3,004			Township.	
Wheatland Township—Total last report.				3,004	3,004	\$2,004.00	9-29-11	Township.	
Wheatland Township.....	E	819	.....	.....	2,004	\$2,002.00	9-29-11	Township.	
Schoenck County:								County.	
Germfalk Township.....	B	1774	4-4-12	.752	.752			County.	
Germfalk Township.....	B	1773	4-4-12	.502	.502			County.	
Germfalk Township.....	B	1775	4-4-12	.986	.986			County.	
Manistique Township.....	E	1430	7-26-11	3,041	2,250			County.	
Mueller Township.....	E	1429	7-26-11	1,141	1,141			County.	
Thompson Township.....	E	1772	4-4-12	5,044	5,044			County.	
Shiawassee County:									
Bennington Township—Total last report.	B	858	6,000	2,000	\$1,000.00	8-19-10	Township.	
Bennington Township.....				1,000	\$500.00		Township.	
				6,000	3,000	\$1,500.00			

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Caledonia Township.....	B	1404	7 18 11	1,000	1,000	500 00	10-3-11	Township.
Caledonia Township.....	B	1405	7 19 11	1,000	2,000	1,000	\$500 00	Township.
Owosso Township—Total last report.....	B	897		2,000	1,000	\$500 00		Township.
Owosso Township.....	B	828		1,000	1,000	\$500 00	9-29-10	Township.
Owosso Township.....	B	1654	9-6-11	.500			10-27-10	Township.
Perry Township—Total last report.....	B	881		1,004	1,004	\$502 00	10-4-10	Township.
Perry Township.....	B	1316	6 14-11	1,000	1,000	500 00	9-11-11	Township.
Perry Township.....	B	1542	8 28-11	1,495	1,000	250 00	9-11-11	Township.
Perry Township.....	A	1543	8 28-11	1,032	500	250 00	9-11-11	Township.
Shiawassee Township.....	B	1320	6 15-11	1,000	1,000	\$500 00	11-22-11	Township.
Vernon Township—Total last report.....	A	1447	8 11-11	1,494	1,494	\$374 00	9-6-11	Township.....
Vernon Township.....	A			2,494	1,494	\$374 00		Cancelled.
Tuscola County:								
Almer Township—Total last report.....	B	237		3,320	2,000	\$2,000 00		Township and district.
Almer Township.....	E	475			182	91 00		Township.
Almer Township.....	B	475			750	750 00		District.
Almer Township.....	B	1083	9 22-10	2,006	2,006	34 00	8-23-10	District.
Almer Township.....	B	1254	5 10-11	1,004		1,003 00	8-23-10	Township.
Almer Township.....	B			6,330	5,006	\$3,878 00	9-22-11	District.
Arbelia Township—Total last report.....	B	1304	6 6 11	2,098	2,008S	\$1,004 00		Township.
Arbelia Township.....	B			2,510				Township.
Columbia Township—Total last report.....	B			4,518	2,008	\$1,004 00		Township.
Dayton Township—Total last report.....	B	817			1,212			
Dayton Township.....	B	816		2,000	1,000	\$500 00	6-29-11	Township.
Dayton Township.....	B				500	250 00	1-7-11	Township.
Elkland Township—Total last report.....	B	658		2,000	1,500	\$750 00		Township.
Elkland Township.....	B	659		11,990	9,996	\$4,998 00	10-19-10	Township.
Elkland Township.....	B					488 00	8-30-11	Township.
						497 00		

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Case.	Date of application.	Length.	Reward paid.	Built by.	Remarks.
Tuscola County—Con.						
Elkland Township.....	B 1102	10-17-10	2,000	1,000	\$500 00	12-15-11 Township.
Elkland Township.....	B 1614	10-4-11	1,974	.....	.....	.....
Ellington Township—Total last report.....			15,964	12,986	\$6,433 00	.....
Ellington Township—Total last report.....	B 1292	5-10-11	2,000	1,000	\$500 00	Township.
Ellington Township—Total last report.....	B 1577	9-11-11	1,056	.....	.....	District.
Ellington Township—Total last report.....	B 1577	.....	.500	.....	.....	Township.
Elmwood Township—Total last report.....			3,556	1,000	\$300 00	.....
Elmwood Township.....	B 515	.....	8,033	4,025	\$2,013 00	Township.
Elmwood Township.....	B 921	.....	.....	1,000	500 00	Township.
Elmwood Township.....	B 922	.....	.....	1,000	500 00	Township.
Fremont Township—Total last report.....			8,033	7,025	\$3,513 00	.....
Fremont Township—Total last report.....			1,030	.....	.....	Township.
Indianfield Township—Total last report.....	B 833	.....	2,868	1,000	\$300 00	.....
Indianfield Township.....	B 1253	5-10-11	1,000	1,000	934 00	Township.
Indianfield Township.....	B 1788	4-30-12	.822	.....	500 00	Township.
Indianfield Township.....	B 1819	5-22-12	2,308	.....	.....	District.
Indianfield Township.....						District.
Millington Township—Total last report.....			6,988	3,868	\$1,934 00	.....
Millington Township.....	B 103	10-18-10	8,016	5,024	\$2,512 00	Township.
Millington Township.....	B 104	10-18-10	1,098	.....	.....	Township.
Millington Township.....	B 410	7-20-11	1,016	.....	.....	Township.
Millington Township.....	B 1411	7-20-11	1,012	.....	.....	Township.
Millington Township.....	B 1412	7-20-11	.488	.....	.....	Township.
Millington Township.....						
Novesta Township—Total last report.....			12,642	5,024	\$2,512 00
					2,000	Township.

STATE HIGHWAY COMMISSIONER.

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Vassar Township.....	B	1218	5 10-11	.517	Township.
Vassar Township.....	B	1219	6 10-11	.500	Township.
Vassar Township.....	B	1480	8 9-11	.888	Township.
Watertown Township.....	B	1285	5-29-11	1.905	Township.
Van Buren County:					
Baileor Township.....	B	1844	6 8-12	1.000	Township.
Bloomingdale Township.....	B	1134	12-21-10	416	Township.
Bloomingdale Township.....	B	1135	12-21-10	.588	Township.
Bloomingdale Township.....	B	1371	7-11-11	.250	Township.
Bloomingdale Township.....	B	1372	7-11-11	.488	Township.
Bloomingdale Township.....	B	1373	7-11-11	.250	Township.
Genesee Township - Total last report.....				2.000	Township.
Genesee Township.....	E	1613	10-3-11	1.000	Township.
Genesee Township.....	E	1642	10-14-11	.331	Township.
Genesee Township.....				.250	Township.
Lawrence Township.....	B	1842	6-1-12	1.000	Township.
Paw Paw Township Total last report.....				2.000	Township.
Pine Grove Township - Total last report.....				12.032	Township.
Pine Grove Township.....	B	307	.....	3.000	9-21-11
Pine Grove Township.....	B	158	.....	.750	Township.
Pine Grove Township.....	B	601	.....	.100	Township.
Pine Grove Township.....	B	845	.....	.150	Township.
Pine Grove Township.....	B	946	.....	1.382	Township.
Pine Grove Township.....	B	1010	8-15-10	.924	Township.
Pine Grove Township.....	B	1327	6-19-11	.500	Township.
Pine Grove Township.....	B	1328	6-19-11	.266	Township.
Pine Grove Township.....	B	1329	6-19-11	.331	Township.
Pine Grove Township.....	B	1331	6-19-11	.340	Township.
Pine Grove Township.....	B	1332	6-19-11	.644	Township.
Pine Grove Township.....	B	1627	6-19-11	.488	Township.
Pine Grove Township.....	B	1628	10-11-11	.122	Township.
Pine Grove Township.....	B	1682	10-11-11	.130	Township.
Pine Grove Township.....	B	1913	12-1-11	.250	Township.
Pine Grove Township.....	B	1914	6-28-12	.334	Township.
Pine Grove Township.....	B	1915	6-26-12	.250	Township.
Pine Grove Township.....	B	1916	6-26-12	.340	Township.
Pine Grove Township.....	B	1917	6-28-12	.384	Township.
Pine Grove Township.....	B	1918	6-26-12	.500	Township.
				17.761	6.572
					\$3,286 00

Cancelled.

FOURTH BIENNIAL REPORT.

TABLE NO. 10.—Continued.

County and township.	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
	Applied for.	Built.				
Van Buren County—Con.						
South Haven Township—Total last report.						
A 434		3. 500				
E 1251	5-16-11	.500	\$125.00	10 3 11	Township.	
B 99	6-12-11	.500	.500	9-18-11	Township.	
A 1629	10-11-11	.988	.988	11-28-11	Township.	Reopened.
E 435			.500	242.00	Township.	
A 1837	10-26-11	.377	.500	9-18-11	Township.	
E 1658	10-26-11	.250			Township.	
A 1835	11-20-11	.198			Township.	
B 1834	6-1-12	.500			Township.	
E 1835	6-1-12	.500			Township.	
E 1845						
B 1846	6-8-12	518			Township.	
B 1846	6-8-12	1.004			Township.	
E 1846		1.522			Township.	
Waukegan Township—						
Waukegan Township—Total last report.						
B 1932	6-19-12	1.034			Township.	
B 1932		1.000			Township.	Withdrawn.
Washtenaw County—						
Manchester Township—Total last report.						
Salem Township—Total last report.						
Wayne County—						
Brownstown Township—Total last report.						
Dearborn Township—Total last report.						
Dearborn Township—Total last report.						
Dearborn Township—Total last report.						
Dearborn Township—Total last report.						
Dearborn Township—Total last report.						
Econe Township—Total last report.						
E 372		2.500	\$1,932.00	10 9 11	County.	Changed to F, 8-14-11.
E 546			.317	9-6-11	County.	Changed to F, 8-1-11.
E 1013	8-16-10	.750	.250	9 11-11	County.	Changed to F, 8-1-11.
E 1018	8-16-10	.250	.183	10 9-11	County.	Changed to F, 8-1-11.

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Eaton Township.....	F 1473	8-1-11	1.124	County, County,
Eaton Township.....	F 1608	10-2-11	.982
Gratiot Township—Total last report.....	F 902	.....	5.586	3.433	\$3,433.00
Gratiot Township.....	F 1465	8-1-11	1.532	1.104	\$1,104.00
Gratiot Township.....	F 1465	.....	1.532	1.532	1,532.00
Grose Pointe Township—Total last report.....	E 683	.....	2.872	2.636	\$2,636.00
Grose Pointe Township.....	E 1466	8-1-11	.263	.500	.....
Grose Pointe Township.....	F 1466	.....	.263	.503	\$503.00
Greenfield Township—Total last report.....	E 340	.....	1.332	.263	.....
Greenfield Township.....	E 496	.....	1.332	.263	.....
Greenfield Township.....	E 497	.....	1.231	.250	.....
Greenfield Township.....	B 639	.....	1.231	.250	.....
Greenfield Township.....	E 829	.....	1.114	.164	.....
Greenfield Township.....	E 890	.....	1.116	.114	.....
Greenfield Township.....	E 891	9-12-10	.500	.963	963.00
Greenfield Township.....	B 1063	8-1-11	1.186	1.073	1,073.00
Greenfield Township.....	F 1464	.....	1.186	1.073	1,073.00
Greenfield Township.....	F 1464	.....	9.558	7.989	\$7,384.00
Hanover Township—Total last report.....	E 312	.....	9.370	1.694	\$1,694.00
Hanover Township.....	E 640	.....	.....	.111	.....
Hanover Township.....	E 964	7-18-10	.703	.565	565.00
Hanover Township.....	E 974	7-29-10	.435	.703	703.00
Hanover Township.....	F 1467	8-1-11	1.000	.435	435.00
Hanover Township.....	F 1468	8-1-11	.744	.454	454.00
Hanover Township.....	F 1468	.....	12.252	4.962	\$4,962.00
Hantramck and Gratiot Townships—Total last report.....	F 318	.....	1.500	1.136	\$1,136.00
Hantramck and Gratiot Townships.....	F 318	.....	.....	.364	364.00
Livonia Township.....	B 1016	8-15-10	.704	.704	\$352.00
Livonia Township.....	B 1016	.....	1.500	1.500	\$1,500.00
Livonia Township.....	B 1016	6-21-11	County,

Changed to F, 8-1-11.

379 Cancelled.

Changed to F, 8-14-11.

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TABLE NO. 10.—Concluded.

County and township.	Date	No. application for	Date of application.	Length.	Reward paid.	Date of payment.	Built by.	Remarks.
	Class	Cause		Applied for.	Built.			
Westmoreland County—Con. Haring Township—Total last report.	B	726		3.275	1.136	\$68 00	8-30-10	County, County, County, Township.
Haring Township—Total last report.	C	1385	7-17-11	.96	1.144	858 00	7-14-11	County, County, County, Township.
Haring Township—Total last report.	B			4.271	2.280	\$1,426 00		
Henderson Township—Total last report.	B	981	7-30-10	2.002	\$1,001 00		Township, Township, Township, Township.	
Henderson Township—Total last report.	B	982	7-30-10	.634	.664	332 00	11-10-10	Township, Township, Township, Township.
Henderson Township—Total last report.	B	1225	5-10-11	1.076	1.076	538 00	11-20-11	Township, Township, Township, Township.
Henderson Township—Total last report.	B			.560	.560	250 00	11-26-11	Township, Township, Township, Township.
Liberty Township—Total last report.	B	1027	8-18-10	4.22	4.22	\$2,121 00		
Liberty Township—Total last report.	B	1028	8-18-10	.522	.522		Township, Township, Township, Township.	
Liberty Township—Total last report.	B	1029	8-18-10	.970	.970			
Liberty Township—Total last report.	B			.566	.566			
Selma Township—Total last report.	B	794		2.088				
Selma Township—Total last report.	B	1912	6-26-12	2.933	.985	\$92 00	County, County, County,	
Selma Township—Total last report.	B			1.000	1.014	507 00	8-4-10	Township, Township, Township.
Slagle Township—Total last report.	B	894	8-9-11	3.965	1.999	\$999 00		
Slagle Township—Total last report.	B	1476	8-9-11	1.532	1.502	\$751 00	4-17-11	Township, Township, Township, Township.
Slagle Township—Total last report.	B	1477	8-9-11	.534				
Slagle Township—Total last report.	B			.438				
South Branch Township—Total last report.	B	940		4.504	1.502	\$751 00		
South Branch Township—Total last report.	B	841		3.002	.502	\$1,000 00	0-26-10	Township, Township, Township, Township.
South Branch Township—Total last report.	B	1348	6-28-11	1.500	.502	251 00	6-28-10	Township, Township, Township, Township.
South Branch Township—Total last report.	B	1814	6-22-12	1.494	1.494	747 00	11-7-11	Township, Township, Township, Township.
South Branch Township—Total last report.	B			1.478	1.478			
South Branch Township—Total last report.	B			5.974	4,406	\$2,248 00		

STATE HIGHWAY COMMISSIONER.

Springerville Township	B	1343	6-28-11	.500	.....	.....	.....	Township.
Springerville Township	B	1272	5-18-11	.992	.....	.....	.....	County.
Springerville Township	C	1551	9-5-11	1.000	.....	375.00	10-3-11	Township.
Springerville Township	C	1552	9-5-11	1.000	1.000	750.00	10-3-11	Township.
				2.992	1.500	\$1,125.00		
Westford Township - Total last report.	B	791	.....	1.000	.....	.....	.....	County.
Westford Township	B	1274	5-18-11	1.508	1.000	\$500.00	8-1-11	County.
Westford Township	B	1420	7-25-11	1.048	.....	.....	.....	Township.
				3.556	1.000	\$500.00		

STATE REWARD ROAD LAW.

Chapter V, Act 283, 1909, as Amended.

STATE REWARD FOR ROADS.

SECTION 1. There is hereby created and established a state highway department, which shall be charged with the giving of instruction in the art of building, improving and repairing public wagon roads and bridges, collecting reports from township and county highway commissioners, overseers of highways and superintendents and commissioners of streets in villages and cities, and with the distribution of any State reward for improving the public wagon roads, that this legislature or any future session may provide for, or any funds that may be given to the State for such purposes by the United States government.

SEC. 2. The chief officer of said department shall be denominated the state highway commissioner. He shall be a citizen of this State and shall have his office at the seat of government and shall personally superintend the duties thereof. He shall be appointed by the governor, by and with consent of the senate, on or before the first day of July, nineteen hundred nine, and shall hold his office on and after said first day of July, nineteen hundred nine, until the first day of July, nineteen hundred thirteen, and until his successor is duly elected and qualified as hereinafter provided. In the year nineteen hundred thirteen, and every four years thereafter, a state highway commissioner shall be nominated and elected by the people of the State of Michigan at the same time and in the same manner as the justices of the supreme court are nominated and elected. He shall take his oath of office July first, following his election, and his term of office shall be four years from that date and until his successor is duly elected and qualified. He shall receive an annual salary of two thousand five hundred dollars. The state highway commissioner may appoint a deputy who shall be a competent civil engineer. Such deputy shall take and subscribe the oath of office prescribed by the constitution, and whenever the commissioner shall be disabled from executing the duties of his office, his deputy, duly appointed, shall execute the duties thereof until such disability be removed. Such deputy shall receive an annual salary of eighteen hundred dollars. The commissioner may employ such other clerks or employees as may be necessary to perform the duties incumbent upon the department. The salaries of the commissioner, deputy commissioner and others employed by authority of this act shall be paid upon the warrant of the auditor general in the same manner as other State officers and employees are paid; and all other expenses shall be approved by the board of state auditors and paid upon the warrant of the auditor general. Whenever a vacancy shall occur in said office of commissioner by reason of death, resignation or otherwise, the governor shall fill such vacancy by appointment, but such appointee shall hold office only until the next general State election when a new commissioner shall be elected for the unexpired term. The commissioner so appointed shall, within fifteen days from



Grading crew at work and a finished gravel road in Wexford County.

the time of notice of his appointment, take and subscribe the oath of office prescribed by the constitution, and shall file the same in the office of the secretary of state, and the said commissioner shall give to the people of the State of Michigan a bond in the penal sum of five thousand dollars, with sureties to be approved by the auditor general, conditioned for the faithful discharge of the duties of his office. The commissioner shall make a biennial report to the governor, which report shall contain the name and compensation of each and every person that may be or has been employed by the department, and the whole amount of the expenses of the department in the interim not previously reported. Such report shall be made on or before the first day of February, nineteen hundred nine, and every two years thereafter, and the commissioner shall have printed a sufficient number of these reports to provide every township highway commissioner and county road commissioner in the State with a copy, and such further number as may be necessary to satisfy the demand that the public weal may warrant.

SEC. 3. The highway commissioners of the several townships in each and every county in the state, and the county highway commissioners in counties working under the county road law, shall meet annually in a road institute, at such time and place in each county or adjoining county as the state highway commissioner may designate, there to consider such matters as he may present to their attention, and to discuss such matters of road improvement as may be of special interest to such township and county highway commissioners, and every township highway commissioner may collect from his township the same per diem for this day as for one spent in actual road work, and his actual expenses in attending such institute shall, if reasonable, be allowed by the township board and shall be paid by said township. Every county highway commissioner may collect from his county the same per diem for this day as for one spent in actual road work, and his actual expenses in attending such institute, shall, if reasonable, be allowed by the board or committee, or county auditors who may have the authority in such matters in the county of which he is a county highway commissioner, and shall be paid by said county.

SEC. 4. At the request of the state highway commissioner, every road district overseer of highways, every township overseer of highways, every township highway commissioner, every county highway commissioner, and every village or city superintendent or commissioner of streets, shall make a sworn report to the state highway commissioner, on or before December first each year, answering such questions as the state highway commissioner shall deem proper to ask and they able to answer, giving him such information as he may require and their ability permit, appertaining to roads, streets, methods of construction, material, machinery and costs, upon blanks which he may furnish and send out.

SEC. 5. Any road district overseer of highways, or township overseer of highways, or township highway commissioner, or county highway commissioner, or village or city superintendent or commissioner of streets, who shall refuse or neglect to make such report at time stated or within thirty days thereafter, when requested to by the state highway commissioner, or who shall, in whole or in part, refuse or neglect to make such report at time stated or within thirty days thereafter, or

FOURTH BIENNIAL REPORT

Sec. 6. *who shall make a report which shall be in whole or in part false, shall be guilty of a misdemeanor, and upon conviction thereof, in any court of competent jurisdiction, be fined in any sum of not less than ten dollars and one hundred dollars and costs, or be confined in jail not less than ten days nor more than thirty days, for each and every offense, at the discretion of the court. Violations of the provisions of this act may be prosecuted in the name of the people of the State of Michigan, and it shall be the duty of the prosecuting attorney of each county to prosecute for any violation of the provisions contained in sections four and five of this chapter.*

Sec. 6. It shall be the duty of the state highway commissioner to furnish outline plans and specifications for the improvement of public wagon roads, and, when requested to, and where proposed improvements are of sufficient importance to warrant, he shall go or send some one, to give expert advice of how to best build or improve public roads or bridges. He shall also gather all the information possible about all kinds of road building material in the State, its relative value, cost, and also cost of transportation to other places in the State, and to give this information upon request to any road or street official in the State free of charge to them.

Sec. 7. The terms, "roads," or "public roads" or "public wagon roads" in this act, shall, at all times, be construed to mean, the leading public wagon roads outside of incorporated villages and cities.

Sec. 8. The state highway commissioner shall keep a complete record of the doings of the state highway department, which record shall be the property of the State, and shall as soon as possible make a map of every township in the State showing the roads and the conditions of the roads, together with marks indicating where road building material can be found, and what kind and what quality.

Sec. 9. Whenever any township shall file notice with the state highway department through its township board, or when any county commissioners in counties under the county road law, shall do likewise, that the township or townships acting conjointly on boundary line roads or county or counties acting conjointly on boundary line roads has made arrangements to improve a mile or more of public wagon road by building a clay gravel, a gravel, a stone gravel, a gravel stone or macadam road, and shall ask for an allotment of state reward, and shall file with the department a profile of the road to be improved, made out by a competent surveyor, and shall make application for outline plans and general specifications, it shall be the duty of the state highway commissioner to enter such application in the order in which it is received, and to furnish the outline plans and general specifications asked for, and provided there are any funds in the state treasury not yet allotted, appropriated for state reward for roads, he shall make the allotment, and providing the fund appropriated for state reward, shall have all been allotted, then the allotment shall be made as soon as there shall be available funds in the state treasury. When any township or townships acting conjointly on boundary line roads or any county or counties acting conjointly on boundary line roads have built a mile or more of such road as is hereinafter described, and when inspected by the state highway commissioner, or by some one acting under authority

of the commissioner is found to be up to the required standard, he shall, providing there are funds in the state treasury for the paying of this reward, verify the same to the auditor general of the state, who shall draw a warrant upon the state treasurer, payable to the proper authorities in such township or county or townships or counties for the amount of reward due them, for the amount and class of road built. And, providing there are no funds in the state treasury for the paying of such reward, as soon as sufficient moneys shall become available, the state highway commissioner shall verify the same to the auditor general, who shall draw his warrant as above set forth: Provided, That the road shall be kept in as good condition as when approved by the commissioner, until the payment of the reward thereon.

SEC. 10. The following described roads, when built, shall merit the reward attached to each description:

(a) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be less than twenty feet between and exclusive of side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide, made of a mixture of sand and clay or other material according to specifications furnished by the state highway commissioner, shall merit, if approved by the state highway commissioner, a reward from the state of two hundred fifty dollars, and pro rata for extra miles and fractions thereof in excess of the first mile;

(b) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be less than twenty feet between side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide, and which shall consist of not less than eight inches of compacted gravel, or not less than twelve inches of compacted burnt shale, which must be applied in not less than two layers, each layer to be rolled separately: Provided, That both shoulders and metaled track shall be properly crowned so as to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the state of five hundred dollars, and pro rata for extra miles and fractions thereof in excess of the first mile;

(c) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be less than twenty feet between side ditches and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide, made in two courses, the bottom course to be crushed stone, slag or other material, if approved by the state highway commissioner, and shall not be less than four inches thick after thorough rolling and a top course consisting of a layer of gravel which shall not be less than three inches thick after being thoroughly rolled: Provided, That both shoulders and metaled track shall be properly crowned so as to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the state of seven hundred fifty dollars, and a pro rata for extra miles and fractions thereof in excess of the first mile;

(d) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be

less than twenty feet between side ditches, and which shall be properly drained and have a wagon way or travel track not less than nine feet wide, made in two courses, the bottom course to be of gravel, slag or other material, if approved by the state highway commissioner, and be not less than four inches thick after thorough rolling, and a top course consisting of a layer of crushed stone which shall be not less than three inches thick after being thoroughly rolled and properly bonded: Provided, That both shoulders and metaled track shall be properly crowned to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the state of seven hundred fifty dollars, and pro rata for extra miles and fractions thereof in excess of the first mile;

(e) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be less than twenty feet between side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide of well compacted macadam not less than six inches thick laid in two courses of crushed stone, each to be properly bonded with stone screenings, asphaltic, bituminous or other cement approved by the state highway commissioner, and thoroughly rolled: Provided, That both shoulders and metaled track shall be properly crowned so as to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the state of one thousand dollars, and pro rata for extra miles and fractions thereof in excess of the first mile;

(f) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall be not less than twenty feet between side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide in the clear between beveled edges and which shall consist of properly laid concrete not less than six inches in depth, composed of Portland cement and gravel, or sand and crushed stone, with or without a paving brick surface: Provided, however, That the cement shall be required to meet the standard tests then in force of the American Society for Testing Materials, and that the other ingredients, the manner of laying and the kind of inspection employed shall be made to comply with specifications made by, or approved by the state highway commissioner, shall merit, if approved by the state highway commissioner, a reward from the State of one thousand dollars per mile and pro rata for extra miles and fractions thereof in excess of the first mile.

Am. 1911, Act 148.

SEC. 11. No claim for State reward for improved roads of over three miles in any one surveyed township, in any one fiscal year shall be allowed by the state highway commissioner: Provided, however, That if any township or county shall have raised money by tax or by sale of bonds to build a mile or more of road such as merits state reward, and the road shall be built and approved by the state highway commissioner, and this road is kept in as good condition as when approved by the state highway commissioner, such township or county shall have application number remain upon the books of the state highway de-



Cut in gravel road in which the sides are not sloping enough to stand against weather and frost. Slope should be $1\frac{1}{2}$ to 1. An excellent quality of gravel used. Not yet compacted.



Gravel road in Almont Township, Lapeer County. Excellent gravel 85% pebbles was used on this road, making a fine surface for country roads.



partment, and draw from the state reward fund each year, until such time as the township or county has received the amount due for the class and the amount of road built: Provided, That money has been appropriated for state reward. In case the road building money was raised by the sale of bonds, the state reward money shall be used only for the payment of the principal of the bonds.

Am. 1911, Act 148.

SEC. 12. The state highway commissioner is hereby given the authority to refuse to grant any further road reward to any township or county that has been rewarded by the state for improving roads, that does not keep these state rewarded roads in proper repair, but, upon his refusal to any township or county for an allotment of state reward, it shall be the commissioner's duty to inform such township or county of what repairs are necessary to place them in a position to again be eligible to receive state reward, and if these repairs are made satisfactorily to the commissioner, he shall reinstate them to the eligible reward list.

SEC. 13. The decision of the state highway commissioner shall be final, relative to whether the road is built well enough or not to merit state reward, and shall have the right to retain any amount of the reward he deems advisable until the road has been thoroughly tested.

SEC. 14. There shall be assigned to the state highway commissioner, by the board of state auditors, suitable rooms at Lansing, for the conducting of the business of the state highway department, and they shall provide suitable furniture and office equipment.

HOW TO MAKE APPLICATION FOR STATE REWARD ROAD, TOWNSHIPS.

Any township, whether the county in which it is located is under the county road system or not, may make application for state reward.

After the township board has decided to build a mile or more of road, the commissioner shall employ a surveyor or engineer to survey and stake out the road and prepare a profile, showing the grade line of the present road with the grade line which is proposed, and the cuts and fills, in figures as well as by lines, which will be necessary to bring the road to the grade. The profile should also show a plan of the road and a description by which the survey is referred to section corners and section lines. Other requirements of the survey may be found in the circular of directions to surveyors and engineers.

It is convenient and desirable to have the surveyor or engineer prepare the original drawing or profile on tracing cloth; then, all copies made will be in blue print and there will be no chance for error in copying.

When the profile is complete, it should be brought before the township board for approval. If approved, the clerk should certify to fact on the profile. viz: Approved by..... Township Bo~~r~~

Dated 19...

..... Township Cler~~r~~

Three copies of the profile should be prepared by the surveyor or engineer, one for filing with the township clerk, one for use of the commissioner or foreman who will do the work, and one for filing with the state highway department.

Application blanks for state reward may be had by writing the State Highway Department at Lansing. A separate application for each different location of road should be filled out and signed by a majority of the township board, and, together with the profile of the road, mailed to the State Highway Department at Lansing.

Upon receipt of the application and profile, the State Highway Department will furnish the plans and specifications for the class and kind of road to be built, and when completed an inspection will be made and, if the road is found to be up to the required standard, the amount of reward merited will be paid. If the department can be of assistance during the process of construction, in choosing gravel or stone, or advising regarding grading, etc., write and you will be given all the help possible.

No reward can be paid to any township or county which has not filed with the State Highway Department application and profile of the proposed road before building.

ENGINEERS AND SURVEYORS.

Surveyors and Engineers making surveys and plans for state reward roads should give the following suggestions careful attention.

(1) In establishing center line of road, section and quarter corners must be found in place. If no permanent monument exists, corners must be established in accordance with rules of the Government survey and permanent monuments set.

(2) Stakes with hubs should be set one hundred feet apart along each side of the proposed roadway, uniformly twenty-five feet from the center line of the same.

(3) Levels should be taken at each station: (a) on the center line, (b) on the hub at each side stake, (c) in the bottom of each ditch, if there are any ditches. Plus levels should be taken on railroad tracks, on the floors of culverts and bridges, in the beds of streams that serve as outlets for road ditches, and at such other points as the surveyor may deem necessary.

(4) The plan and profile should be placed on the same sheet, projecting the plan vertically above or below the profile. Angles in the line may be indicated by the use of broken lines or small circles, giving the bearings and distances in figures without attempt at laying out with a protractor.

(5) The plan must contain a description of sufficient detail so that the road can be platted on township maps. The description must refer to section lines, quarter lines, section corners, quarter corners. Exact location of point of beginning with bearings and distances of the survey to the terminal must be given. In case of angling roads, where center line crosses section or quarter section lines, the station and plus at in-

tersection and the distance from such intersection to the nearest section or quarter section corner should be noted on the profile. Permanent monuments to be set on center line at all angles.

(6) One hundred feet to the inch horizontal and five or ten feet to the inch vertical are desirable scales. *No smaller scale than two hundred feet to the inch horizontal and twenty feet to the inch vertical will be allowed.* Vertical and horizontal scales should always be noted on the profile.

(7) The profile must show at each station: (a) center line cuts and fills in figures, (b) the depth of each ditch or gutter from the outer side hubs, (c) the distance of the established grade above or below each line of side hubs. *Tabulated cuts and fills on separate sheets are not desirable and will not be accepted in lieu of the profile.* Cuts and fills should balance.

(8) Grade line should show elevation of finished road and not the sub-grade. Points of change in proposed grade line should not be made abrupt, but angles should be rounded off with vertical curves. Avoid, if possible, the use of level grade line. At least six inches incline to one hundred feet is desirable. Elevations of stations at change points should be given referring to located bench marks.

(9) A complete working profile should show: (a) center line profile, (b) profile of each side ditch or gutter, (c) all the figures required to build the complete road as staked out.

(10) A typical cross-section should be shown. State law requires that turnpike be at least twenty feet between and exclusive of side ditches with an average crown of one inch to one foot.

(11) At least three sets of plans must be prepared, one for filing with the township or county clerk, one for filing with the State Highway Department, together with the application for reward, and one for use of commissioner or foreman doing the work. Surveyors and engineers should provide themselves with application blanks for state reward roads and fill in description ready for the signing of the township board or county commissioners.

(12) All profiles must be approved by township boards or county road commissioners, before filing with the State Highway Department.

(13) It is desirable to prepare the original profile on tracing cloth, the surveyor or engineer retaining it, and as many prints as may be required can be furnished the township or county. Profile tracing cloth, Standard cross-section 10 x 10, is very convenient for this class of work and is recommended by the State Highway Department.

(14) Profiles, which do not in the main comply with these requirements, will be returned for corrections to the surveyor or engineer making the same. No application for state reward will be filed by the State Highway Department until both profile and application are approved by the Commissioner.

LAW RELATING TO SURVEYS.

Sec. 16, Ch. I, Act 283, Laws of 1909, relative to surveys, reads as follows, and is authority for the above suggestions.

"Whenever a highway shall be laid out or altered, the commissioner, mayor or president of any city or village shall cause an accurate survey to be made of the center line thereof, describing the commencing and terminating points of the same from some established corner of a regular subdivision of a section, or other determinable point. Bearing trees or monuments shall also be noted at such commencement and termination and at each angle along the line of the road when practicable. Whenever a road not on a section, quarter section, or some other regular subdivision line of a section, crosses a section line, the distance from the last preceding angle in such road to such section line shall be noted; also the distance from the point of intersection to the nearest section corner post, quarter post, or meander post on one side of such point, if there be one within one mile, and the premises belonging to any highway shall be a parcel of land not less than two rods wide on each side of the line of survey. When the survey is made, permanent monuments shall be established by the surveyor every eighty rods along the line of such highway."

Sec. 15, Ch. II of said law, relative to permanent improvement on roads and bridges reads as follows:

"All work hereafter done upon roads and bridges, except such work as may be required for repairs, shall have in view the permanent improvement of such roads and bridges. Before beginning such permanent improvement on any highway, the commissioner shall cause a survey of the highway to be made by a competent surveyor, for the purpose of establishing both its location and grade, and a profile of such survey shall be made. Grade stakes shall be set along the side or sides of the highway, such grade lines being referenced to permanent objects along the highway at frequent intervals. The profile shall also show in figures as well as by lines, the cuts and fills required to bring the road surface to established grade. Such plan and profile shall be referred to the township board for its approval and adoption. If, in the judgment of such board, the grades as proposed are not practicable and advisable, new grades shall be indicated on the profile, which grades shall be agreeable to said board. The plan and profile as submitted, or amended as above provided, shall be adopted by resolution of such township board, which facts shall be certified by the township clerk on the plans, giving the date of such adoption, after which they shall be filed with the township clerk. Thereafter all parts of such roads shall be graded and turnpiked in accordance with the grades thus established before the same shall be graveled or macadamized, and it shall be unlawful for the highway commissioner to issue any orders for permanent improvement work, for the township clerk to countersign such orders, or the treasurer to pay same, unless the survey has been made, the profile made and adopted, and the work done in accordance therewith, and any one of the officials that shall

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"Whenever a highway or president of to be made of the center terminating points of a regular subdivision of a section or monuments shall also be made at each angle. Whenever a road not on the subdivision line of a section the last preceding angle, also the distance from corner post, quarter posts there be one within one mile shall be a parcel of land line of survey. When be established by the state highway."

Sec. 15, Ch. II of said law and bridges reads as follows:

"All work hereafter to be done as may be required for the improvement of such roads and highways on any highway to be made by establishing both its location and be made. Grade stakes for the highway, such grade lines for the highway at frequent intervals as well as by lines, the center established grade. Surveyor's board for its application board, the grades as indicated by the said board. The plan provided, shall be adopted facts shall be certified date of such adoption, by the clerk. Thereafter all contracts in accordance with the graveled or macadamized missioner to issue any township clerk to county unless the survey has been done in accordance

do what is prohibited in this paragraph knowingly, shall be guilty of a misdemeanor and shall be liable to a fine not less than ten dollars and not more than twenty-five dollars, and in default of payment may be confined in the county jail not less than ten days, nor more than twenty-five days, in the discretion of the court. The highway shall be constructed in such manner as to form a turnpike sufficiently crowning to shed water, with gutters or ditches adequate for drainage. The width of the turnpike shall be not less than eighteen feet between side ditches and all bridges shall have a clear roadway of at least sixteen feet, and shall be capable of carrying a ten ton moving load."

On the folded sheet following will be found a standard profile which gives a large amount of detail and a profile of this character, is, consequently, very desirable. Engineers, before making a profile for state reward roads, shoud give this folded sheet careful study.

DISCUSSION OF CLASS "A" ROAD.

Class A road is intended to cover about four divisions of construction, as follows:

First, thin gravel road, in which the gravel used runs sixty percent or better in pebbles and is put on the road nine feet wide and not less than six inches thick. It is intended that this be constructed on very lightly traveled roads, where six inches of gravel is sufficient to sustain loads.

Second, poor clay or sand gravel road, where gravel which runs sixty per-cent pebbles is not obtainable within reasonable haul. It is not intended nor economical for localities having good gravel to construct class A road.

Third, on heavy soils where no gravel is available, it is allowable to construct sand-clay roads, in which an approved mixture of sand and clay be harrowed together with a disc in two courses. It is intended that the metal track shall be such thoroughly mixed sand and clay that it will not mud in wet weather nor disintegrate in dry weather.

Fourth, on light sandy soils where bank clay is available for construction purposes, clay-sand construction may be built by hauling on clay and discing in two courses so as to obtain a surface six or eight inches thick and nine feet wide, which will not mud in wet weather nor disintegrate in dry weather.

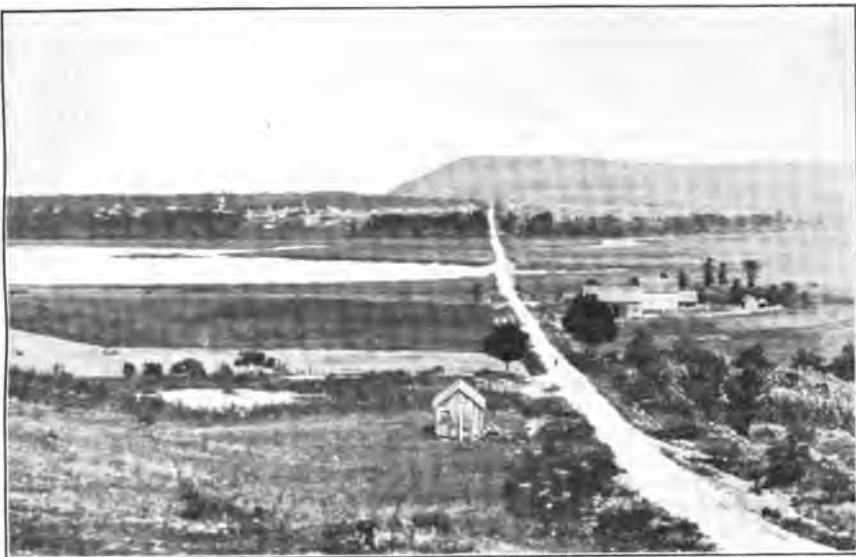
Taking up the above four divisions of class A road, it can be said under the first division that it is not desirable to construct a six-inch gravel road except in poor communities where a limited amount of money is available for road work and where the travel is light. The typical specification for this class of road is exactly the same as the class B road, for which five hundred dollars per mile is payable, except that the gravel is put on in one course and is six inches thick after thoroughly compacting.

The second division of class A road allows gravel, either sandy or clayey, which runs as low as forty percent pebbles. In cases where the road is of heavy soil, the filler in the gravel would better be of a sandy

nature, and where the road is to be constructed on a light sandy soil, the filler in the gravel should be clayey. It can be said that more class A roads have been constructed under this plan than any other. Localities having no gravel pits, in which the gravel runs a test of sixty per cent, which is required for class B roads, construct this road with good results. The bed, shoulders and turnpike are prepared the same as for any other state reward road, viz.: Ditches sufficient to take care of all surface water, turnpike between ditches measuring twenty feet in width and a gravel bed at least nine feet wide. The gravel is put on in two courses, the bottom course five inches thick compacted and the top course three inches thick compacted, making eight inches thick in all, the same as for class B roads. Very clayey gravel should never be used upon heavy, poorly drained soil, and vice versa, sandy gravel of this poor nature should never be placed on light sandy soil.

Under the third division, which we designate sand-clay, meaning that the unimproved road is on heavy, rather poorly drained soil, we specify that the grading shall be done the same as for other classes of state reward road, viz.: Sufficient ditches provided to take care of surface water, tile drains provided where necessary, the turnpike shall be built at least twenty feet wide between inside slopes of ditches and that the metal track be built nine feet wide with seven inches of an approved mixture of sand and clay. The first course of sand should be placed on the road at least five inches thick and nine feet wide and enough clay, about two inches, be crowded over this course with a grader. This bottom course should then be thoroughly harrowed with a disc harrow, adding clay occasionally from the sides until the material becomes thoroughly mixed. It is desirable to wet this course during harrowing, and this may in many cases be done by taking advantage of occasional rains. When this is completed and smoothed down with a grader, three inches more of sand should be added and spread uniformly nine feet wide and about one inch of clay should be crowded in from the sides and the whole top course again thoroughly worked with the disc harrow with occasional sprinkling. If the resultant mixture is muddy, more sand should be added until a surface is reached which will not mud in wet weather. It is desirable to leave the surface somewhat sandy on account of clay tracking in from the sides and shoulders. The crown of the road should not be less than ten inches on a road twenty feet wide.

On roads which are sandy, the fourth division of class A roads can be constructed to very good advantage. The road should be graded and crowned as usual. Generally, no side ditches are necessary for the water sinks rapidly away after rains. It should only be necessary to crown the road sufficiently to remove the water from the metal track. This track should be formed as follows: Four inches clay placed in the trench which is previously prepared, as in all state reward roads, taking care to spread it uniformly nine feet wide. Over this, should be crowded in from sides sufficient sand from the shoulders and gutters to make about three inches. This material should be thoroughly harrowed with a disk harrow until the sand nearly disappears into the clay and the clay works to the top, when it should be sprinkled or advantage taken or rains, when again sand should be crowded in from the sides suffi-



Unusual road view in Manistee County. Gravel road leading to Arcadia from south. Gravel sixteen feet wide on this road.



Muskegon County. Water bound limestone road built on light sandy soil. Note the width of turnpike and absence of large ditches which are unnecessary on this soil.

cient to leave about one inch of loose sand on the surface of the bottom course. To this should be added one or two inches of clay and spread to the full nine foot in width, which in turn should be thoroughly mixed with the sand already on the road. This top course should be disc harrowed and sprinkled until a smooth even surface is obtained which will shed water and will not mud under heavy rains nor disintegrate in dry weather. As the road is worn and rutted with travel, additional sand can be drawn in from the sides, the tendency of the clay in the bottom course being to come to the surface and mud.

It must be borne in mind by persons in localities which desire to build class A roads that if good gravel is obtainable within a reasonable haul, say three miles, there is no economy in the class A construction, and at best a sand-clay road does not rank with a gravel road. The construction cost of a sand-clay road varies from one thousand to as high as eighteen hundred dollars per mile. The higher cost, it can be seen, does not vary much from the cost of gravel roads. Townships and counties desiring to construct this class of road should place their application in the hands of the State Highway Department early in the season so that an engineer can be sent over the ground where the road is proposed to be built and recommend special treatment where necessary. It is then possible to determine the quality of clay and sand or the grade of gravel which is to be used. No regular specifications are put out for class A roads as are for the standard state reward roads, on account of the great variety of local conditions.

GENERAL SPECIFICATIONS FOR ROADS, CLASS B.

Section 10, Chapter V, Act No. 283, Public Acts 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of side ditches or gutters and have a cross-section oval in form, with an average rise of one inch to the foot from the inner edge of such ditch or gutter to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads, and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. In general, earth for fills should be taken from cuts. In no case shall deep unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see cut on page — appendix.

Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand and must be formed with true grades, having sufficient incline to furnish a free and uniform flow

of water to the nearest natural outlets, which outlets must be so improved, where necessary, as to carry the water quickly away from the highway. The slope of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed at such places and of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders described in the next paragraph, making outlets into the side ditches for water that may collect in the gravel bed during construction and later before the surface becomes hard and water proof. Such trenches shall be eight inches or more in width and slightly deeper than the gravel bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils and filled with coarse gravel when the first layer of gravel is being applied.

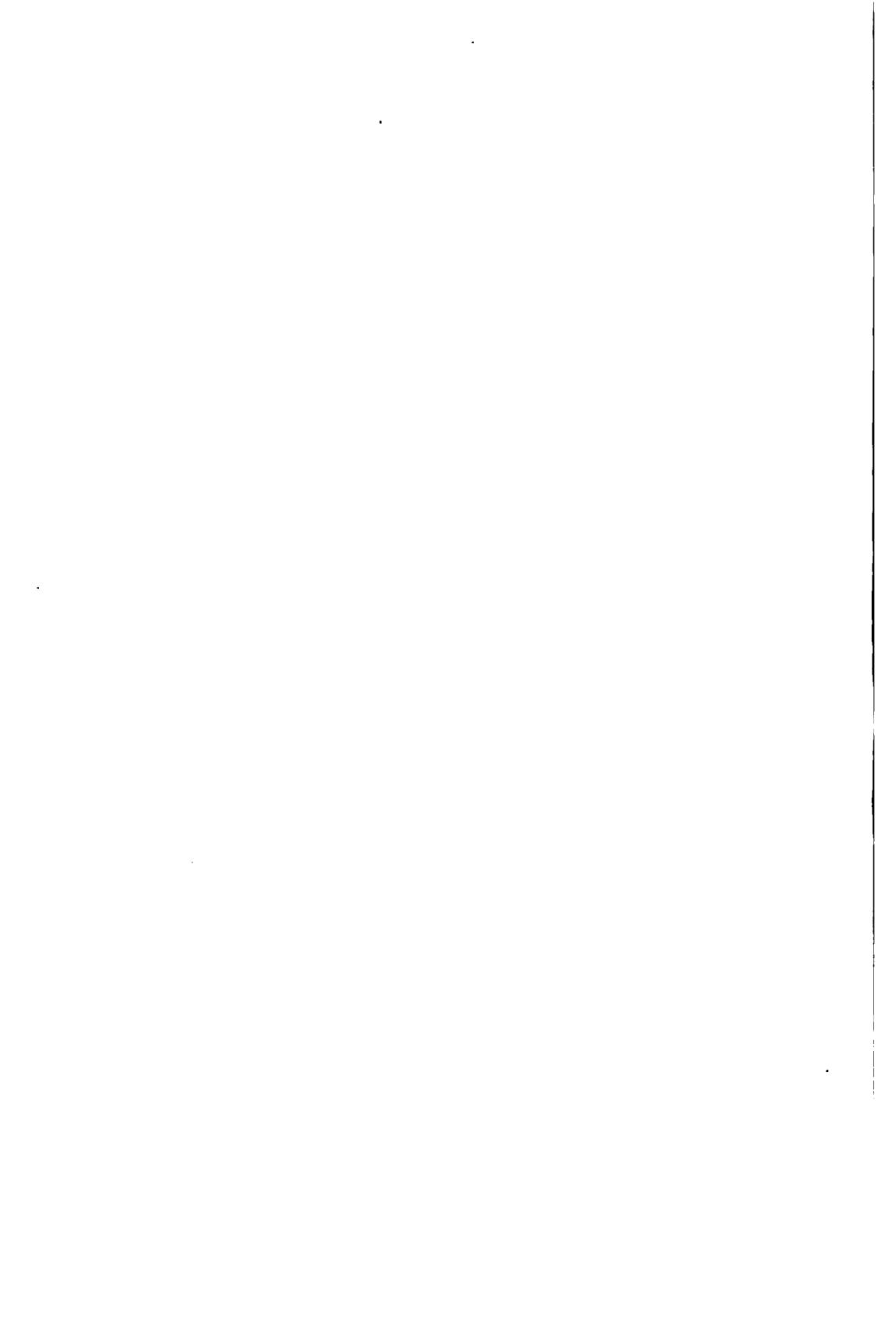
Gravel Bed and Shoulders.—After the road has been graded as above described the gravel bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material shall be placed on each side of the gravel bed not less than nine feet apart or such greater distance as may be required to retain the width of gravel specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-grade.—After the shoulders and gravel bed have been formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition everywhere parallel to the finished roadway, the metal bed being eight inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, rotten straw or fine brush shall be laid on sub-grade to prevent the first course of gravel from mixing with the sand.

First Course of Gravel.—After the road has been graded and rolled in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than five inches deep after compacting, six inches deep, loose measure. The gravel for this course shall consist of good, clean bank gravel, not less than sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two and one-half inch mesh. If clay gravel is used, it should contain only clay enough to coat the pebbles, no free lumps. In no case should the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities. The gravel course shall then be harrowed with a spike tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any



In the foreground of the upper picture is seen shoulders and bed completed ready to receive gravel and in the distance the first course of gravel placed. The lower picture shows the completed gravel road. Not yet compacted.



hollows that may develop in the gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniformly smooth and hard and everywhere parallel to and three inches below the surface of the finished road. The crown can be preserved during construction by the occasional use of the grader or other suitable floating tools. Ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

Second Course of Gravel.—The gravel for the second course shall consist of good, clean bank gravel, sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and will pass through a screen of one and one-half inch mesh. Other requirements for gravel in this course are the same as specified for gravel in the first course. This gravel shall be spread on the road to such uniform thickness as to be not less than three inches deep after compacting, four inches loose measure, after which it shall be harrowed and rolled in the same manner as prescribed for the first course. Any depressions that may be formed during the rolling shall be filled with the kind of gravel prescribed for the second course and the road re-rolled until the surface is uniformly smooth and hard and everywhere conforms to the proposed grade and cross-section of the road.

Manner of Rolling.—Rolling shall be done only when the gravel has been thoroughly wetted by sprinkling or recent rains, and shall at all times begin at the sides, rolling lengthwise of the road, but gradually working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch and the whole road grade left in such perfect condition that water will flow without obstruction to the side ditches. Rolling may be done with a power roller, a heavy horse roller or a traction engine followed by a weighted field roller, if one of suitable strength to bear weighting to three or more tons can be obtained.

With any kind of a roller the spike-tooth harrow, preferably of the lever type, should be used as long as the teeth will penetrate the surface.

Approved February 1st, 1912.

TOWNSEND A. ELY,
State Highway Commissioner.

REPAIRING GRAVEL ROADS.

Section 12, Chapter V, Act No. 283, Public Acts 1909.

"The state highway commissioner is hereby given the authority to refuse to grant any further road reward to any township or county that has been rewarded by the state for improving roads, that does not keep these state rewarded roads in proper repair, but, upon his refusal to any township or county for an allotment of state reward, it shall be the commissioner's duty to inform such township or county of what repairs are necessary to place them in a position to again be eligible to receive state reward, and if these repairs are made satisfactorily to the commissioner, he shall reinstate them to the eligible reward list."

The section of the law above quoted gives the State Highway Commissioner authority to suggest the kind of repairs that should prove most satisfactory on all state rewarded roads.

It is now six years since the first of them were built and some of them have received but little attention since they were completed. Others have suffered from repairs made, when the weather conditions were not suitable, by methods not calculated to give the best results and with material much inferior to that used in the original road. This is especially true of the gravel roads, which have doubtless suffered the most from unskillful repairs.

To maintain a gravel road surface properly, it should have constant attention, the repairs commencing as soon as the road is opened to travel. These repairs will be considered under the heads, viz: (1) Suitable dragging. (2) Patching. (3) Resurfacing.

DRAZZING.

Gravel roads are never hard enough and smooth enough when opened to travel to prevent almost immediate rutting by the wheels of heavily loaded wagons. In fact a gravel which contains enough clay to pack immediately under the roller, or in a few days under travel will always prove to be a muddy road when the frost is going out in the spring, and in prolonged wet spells at other seasons of the year. If such gravels are found on a road they can be greatly improved by covering with a thin layer of sandy gravel, applied when the old gravel is soft and allowed to mix under travel, the road being kept smooth by the frequent use of the road drag.

On any gravel road, dragging with a suitable road drag should begin after the first good rain following the completion of the road and be continued after each subsequent rain until the road surface becomes so hard and smooth that heavily loaded wagons make no impression on the road surface. This means that the dragging must be frequent the first fall until winter sets in, and the following spring until the middle of May or the first of June. After that, the dragging will not be very effective, unless the rains are of long enough duration to slightly soften the surface, and may, therefore, be less frequent. But they will still be found very effective and efficient in the late fall and in the spring, when the frost is coming out and before the gravel is fully settled.



Kalamazoo County road camp. The second cut shows "prisoner's van" in which the county keeps prisoners at night. Lower picture is a finished (partly compacted) gravel road built in this county.





Showing two views of large cut and fill on gravel road in Grand Traverse County, built by County Road Commissioners. Note sodded side slopes and guard rail. Gravel is a little loose and ruts some yet but is hardening under travel.

The plank drag, the log drag, or the various forms of steel drags will be satisfactory for this work. When wooden drags are used, they should be faced with some kind of steel plates.

When this dragging is systematically followed up, it will be found that the cost of maintenance of gravel roads, even with some patching, can be kept below \$10.00 per mile a year.

PATCHING.

This work is usually neglected or done in such a way as to cause two-ruts to form where there was but one before. That is the invariable result of filling a rut too full. This work should always be done when the road is wet, preferably when the water is still standing in every little hollow on the road surface, so that the workmen can see just where to place the new gravel and about how much is required.

Unless the rut is a very large one, it is always best to shovel the gravel from the wagon into it, rather than to raise a side-board and attempt to dump a part of the load.

Patching done in the proper manner when the road is wet, followed by the road drag, will maintain an old gravel road surface as good as new until it is so badly worn that an entirely new surface is required. The gravel used should never be poorer than that forming the surface layer of the old road, and especially should not contain an excess of clay. The best results will be obtained by using the same kind of gravel as was used to build the old road.

This kind of patching should never be done when the old road bed is hard and dry, for then the new material is soon ground into powder and makes dust and mud.

RESURFACING.

The work of resurfacing an old road is much the same as putting on the top layer of gravel when building a new road. If the layer is to be more than three inches thick, it will often be necessary to form slight shoulders by scraping the loose and worn material from the central portion of the road bed to the sides. Frequently, the crown has all been worn off the old road bed, and sometimes more, leaving the old road surface concave or "dishing." In such cases, the new gravel will have to be thicker in the center and "feathered" out at the edges. The new gravel can be kept in proper crown by the frequent use of the road drag, as already described, sometimes supplemented by the use of a road grader.

It should be needless to add that the best gravel obtainable ought to be used for resurfacing. It is also best to do this work in the spring or fall when the old bed is not too hard, so as to prevent any of the new gravel from being ground up under the wheels of heavily loaded wagons, especially if any part of the new layer is less than three inches thick.

It may be proper to add that the gutters and ditches must be kept clear of dirt, rubbish, weeds and brush so that the water always has a free and unobstructed flow to the nearest drains which can remove it permanently from the road.

This department intends to cause an inspection of all old state reward roads before July 1st, 1913.

TOWNSEND A. ELY,
State Highway Commissioner.

GENERAL SPECIFICATIONS FOR ROADS, CLASS C.

Section 10, Chapter V, Act No. 289, Public Acts 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of side ditches or gutters and have a cross-section oval in form, with an average rise of one inch to the foot from the inner edge of such ditches or gutters to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads, and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. In general, earth for fills should be taken from cuts. In no case shall deep, unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see cut on page — appendix.

Tile drains shall be laid where needed at such places, of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders described in the next paragraph, making outlets into the side ditches for water that may collect in the metal bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the metal bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils, and must be filled with slag or stone when the first layer of metal is being applied.

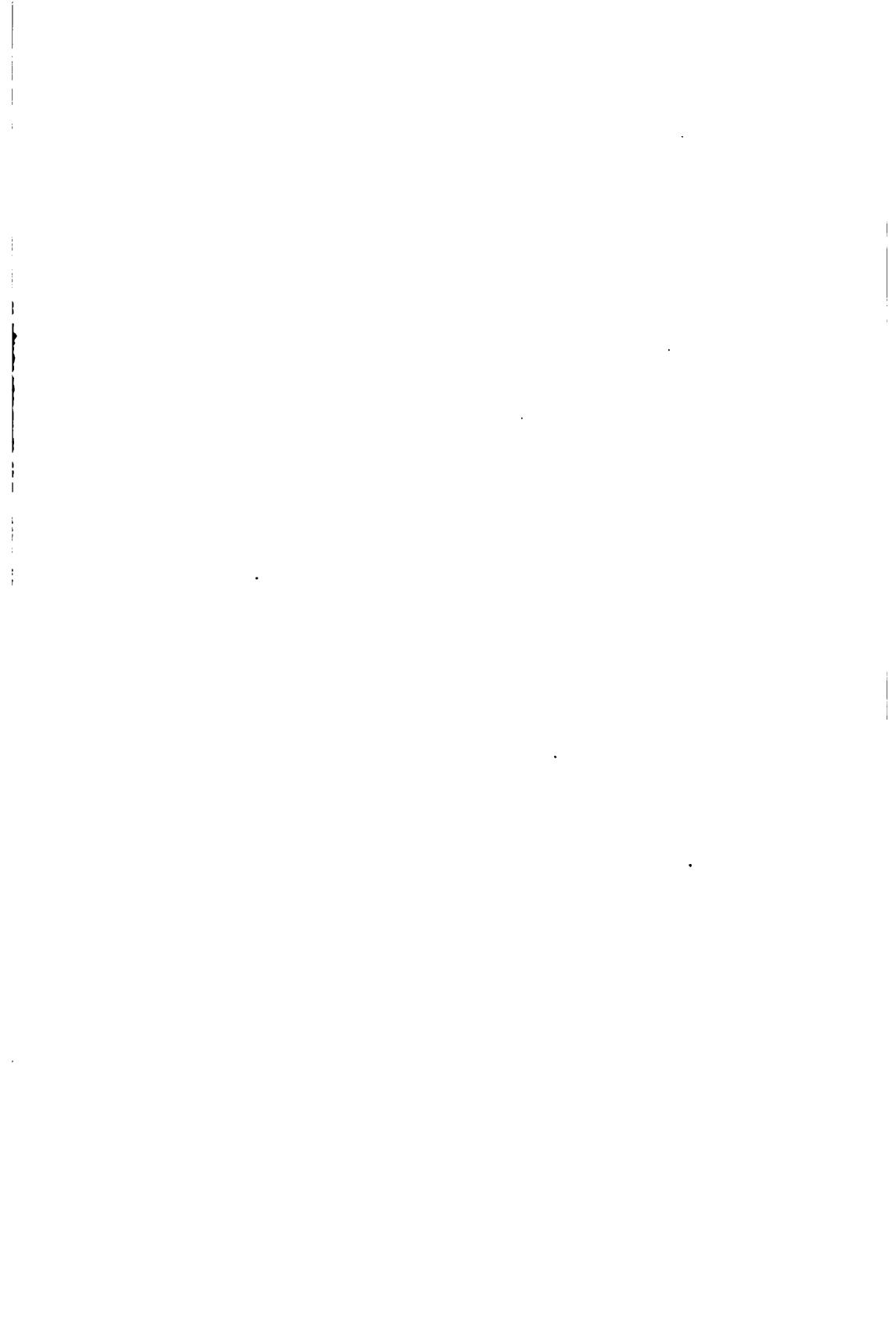
Metal Bed and Shoulders.—After the road has been graded as above described the metal bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material shall be placed on each side of the metal bed not less than nine feet apart or such greater distance as may be required to retain the width of metal specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and metal bed have been formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condi-



Menominee County Shore Road crushing plant and hauling outfit. This pit runs a large per cent of large stone and all the product is run through crusher. Note the wheel scrapers supplying gravel to elevator.

The lower cut shows train load starting for the road from two to six miles distant.



tion, everywhere parallel to the finished roadway, the metal bed being seven inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, rotten straw or fine brush shall be laid on sub-grade to prevent the first course of gravel from mixing with the sand.

Crushed Stone or Slag Course.—After the road has been graded and rolled in the manner above described, a layer of crushed stone or slag shall be spread on the prepared bed to such uniform thickness as to be not less than four inches deep after thorough rolling, five inches deep loose measure. The material for this course may be of a suitable grade of crushed slag, limestone, cobbles or trap rock, and shall consist only of that part of the crusher product passing over the three-fourths inch section and through the three-inch section of the crusher screen. This stone or slag shall be placed upon the road uniformly mixed, no patches of alternately large and small pieces being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required. In no case shall this course be laid on a muddy sub-grade.

Binder for Crushed Stone or Slag Course.—After the stone or slag has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to the uniform depth of from one-half to three quarters of an inch with stone screenings or bank gravel and re-rolled. The amount of binder used shall be somewhat less than enough to fill the voids in the stone. Water may be applied in advance of the roller after the binder is added, if ordered by the officers in charge, but it should be used sparingly on clay sub-grades. The rolling must be continued till the binder is worked into the crevices of the larger stones and the stones cease to sink beneath the roller. If depressions are formed they shall be filled with stones of suitable grade, and not with screenings.

Stone screenings, which are preferable, used to bind this course may be that part of the crusher product passing through the three-fourths inch section of the crusher screen when crushing the stone used for this course. Gravel when used for binder shall be clean bank gravel of the kind hereinafter specified for the gravel top.

Gravel Top.—After the rolling above specified, the stone or slag course shall be covered with a layer of gravel of such thickness as will make a uniform depth of three inches after compacting, four inches loose measure. The gravel shall be clean bank gravel, sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of one and one-half inch mesh. If clay gravel is used it should contain only clay enough to coat the pebbles, no free lumps. In no case shall the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities.

This course shall be floated until the surface is smooth and even, then sprinkled and rolled until no further compacting is possible. Any hollows that may develop in the gravel top during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniform and hard, and everywhere conforms to the proposed grade and cross-section of the road.

Manner of Rolling.—Rolling shall at all times begin at the sides of the road, rolling lengthwise and gradually working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.

Approved February 1st, 1912.

TOWNSEND A. ELY,
State Highway Commissioner.

GENERAL SPECIFICATIONS FOR ROADS, CLASS I.

Section 10, Chapter V, Act No. 283, Public Acts of 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

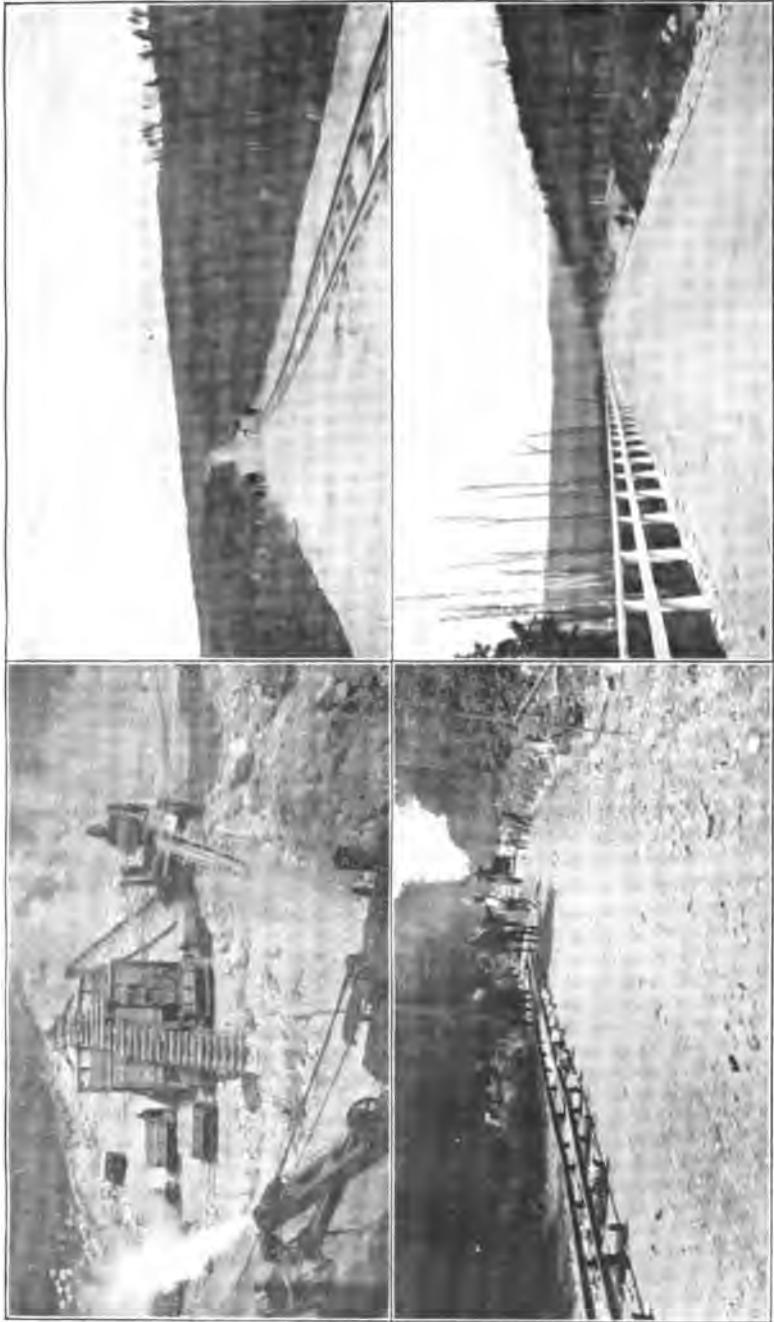
This specification covers only water bound macadam top course. If a bituminous binder is to be used, a special specification must be furnished by, or approved by the State Highway Commissioner.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of side ditches or gutters and have a cross-section oval in form with an average rise of one inch to the foot from the inner edge of such ditch or gutter to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. In general, earth for fills should be taken from cuts. In no case shall deep, unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see cut on page — appendix.

Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand and must be formed with true grades, having sufficient incline to cause a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved where necessary as to carry the water quickly away from the highway. The slopes of the banks of ditches shall not be steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed, at such places, of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders, described in the next paragraph, making outlets into the side ditches for water that may collect in the metal bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the gravel bed. They shall be placed at all low points in the grade and not farther than



Showing work in Iron County, on the Crystal Falls-Iron River Road. Here the gravel pit runs about fifty per cent stone from three inches up in size. The whole product is run through the crusher and screens, making a mixture of screened gravel and crushed stone. This is hauled onto the road in cars over a portable track. The lower right hand cut shows finished road with guard rail. The state pays reward of \$750.00 per mile. Class C.



one hundred feet apart in retentive soils and must be filled with coarse gravel when the first layer of metal is being applied.

Metal Bed and Shoulders.—After the road has been graded as above described the metal bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material, will be placed on each side of the metal bed, not less than nine feet apart, or such greater distance as may be required to retain the width of metal specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center or if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-grade.—After the shoulders and metal bed have been formed as above described, the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition, everywhere parallel to the finished roadway, the metal bed being seven inches below the finished grade and having the same crown. In deep, mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, rotten straw or fine brush shall be laid on the sub-grade to prevent first course of gravel mixing with the sand.

Gravel Bottom.—After the road has been graded and rolled in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than four inches deep after compacting, five inches loose measure.

The gravel for this course shall consist of good, clean bank gravel, not less than sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two and one-half inch mesh. If clay gravel is used it should contain only clay enough to coat the pebbles, no free lumps. In no case shall the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities. The gravel course shall then be harrowed with a spike-tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any hollows that may develop in this course of gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniform and hard and everywhere parallel to and three inches below the surface of the finished road.

The crown can be preserved during construction by the occasional use of the grader or other suitable floating tools.

ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

Slag Bottom.—If slag is used, a layer of crushed slag of an approved quality shall be spread on the prepared bed to such uniform thickness as will make not less than four inches after thorough rolling, five inches deep loose measure. The slag shall consist only of that part of the

crusher product passing over the one-inch section and through the three-inch section of the crusher screen. The slag shall be placed on the road uniformly mixed, no patches of alternately large and small pieces being allowed.

In no case shall the slag course be laid on a muddy sub-grade.

The slag course shall be bonded with gravel or stone screenings, no pieces of which shall be too large to pass through a one-inch screen. The amount of binder used shall be slightly less than enough to fill the voids in the slag. The sprinkling and rolling shall be the same as specified for the macadam top, except that water will be used sparingly on clay sub-grades and always under the direction of the officers in charge.

Macadam Top.—After the gravel course has been applied and rolled as above specified, a layer of crushed stone shall be added, of such uniform thickness as to be not less than three inches deep after thorough rolling, four inches loose measure. The stone for this course may be a suitable grade of crushed limestone, cobbles or trap rock, and, in case of cobbles or trap rock, shall consist only of that part of the crusher product passing over the three-quarter inch section and through the two-inch section of the crusher screen, except for binder as hereinafter specified. When limestone is used for this course, it shall consist only of that part of the crusher product passing over the three-quarter inch section and through the three-inch section of the screen. This stone shall be placed upon the road uniformly mixed, no patches of alternately large and small stones being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required.

Binding for Macadam Top.—After the stone has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to a uniform depth of about three-quarters of an inch with stone screenings. The screenings, when cobbles or trap rock, may consist of that part of the crusher product passing through the three-quarter inch section of the crusher screen when crushing stone for the macadam top. When limestone is used for the binder, the product shall consist of limestone chips ranging in size up to three-quarters inch from which the dust has been removed. The amount of screenings used must completely fill the voids in the larger stones. If depressions are formed they shall be filled with the smaller stones of suitable grade and not with screenings. During the progress of the work the screenings will disappear in places, when more screenings must be added and the rolling and sprinkling continued until the road has a uniformly hard and even surface and everywhere conforms to the proposed grade and cross-section of the road.

Rolling shall at all times begin at the sides of the road, rolling lengthwise, but working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter, and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.

Approved February 1st, 1912.

TOWNSEND A. ELY,
State Highway Commissioner.



Kalkaska County Road Commission.

- (1) Loading and hauling stone from cars.
- (2) Rolling top course of water bound limestone macadam.
- (3) Finished macadam road. Road camp on right.

GENERAL SPECIFICATIONS FOR ROADS, CLASS E.

Section 10, Chapter V, Act No. 283, Public Acts 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

This specification covers only water bound macadam. If bituminous binder is to be used, a special specification must be furnished by or approved by the State Highway Commissioner.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of side ditches or gutters, and have a cross-section oval in form with an average rise of one inch to the foot from the inner edge of such ditch or gutter to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads, and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. For more details as to the manner of forming grades and ditches see cut on page — appendix.

Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand, and must be formed with true grades having sufficient incline to cause a free and uniform flow of water to the nearest natural outlets which outlets must be so improved where necessary as to carry the water quickly away from the highway. The slopes of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed at such places, of such kind and size, and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders, one on each side, described in the next paragraph, making outlets into the side ditches for water that may collect in the macadam bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the macadam bed. They shall be placed at all low points in the grade, and not further than one hundred feet apart in retentive soils, and must be filled with crushed stone when the first layer of macadam is being applied.

Macadam Bed and Shoulders.—After the road has been graded as above described the macadam bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth, or other suitable material, shall be placed on each side of the macadam bed, not less than nine feet apart, or such greater distance as may be required to retain the width of macadam specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the roadgrade is high, the shoulders may be formed by moving earth from the center of the present road grade to the sides



stone shall be added, of such uniform thickness as to be not less than two and one-half inches deep after thorough rolling, three and one-half inches deep loose measure. The stone for this course may be a suitable grade of crushed limestone, cobbles or trap rock, and, in case of cobbles or trap rock, shall consist only of that part of the crusher product passing over the three-quarter inch section and through the two-inch section of the crusher screen except for binder as hereinafter specified. When limestone is used for this course, it shall consist only of that part of the crusher product passing over the three-quarter inch section and through the three inch section of the screen. This stone shall be placed upon the road uniformly mixed, no patches of alternately large and small stones being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required.

Binder for Top Course of Macadam.—After the stone has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to a uniform depth of about three-quarters of an inch with stone screenings. The screenings, when cobbles or trap rock, may consist of that part of the crusher product passing through the three-quarter inch section of the crusher screen when crushing stone for the macadam top. When limestone is used for the binder, the product shall consist of limestone chips, ranging in size from three-quarter inch down, from which the dust has been removed. The amount of screenings used must completely fill the voids in the larger stones. After the screenings are added, water shall be applied with a horse sprinkler and the road rolled and watered until it becomes so hard that a piece of rock will crush beneath the roller before penetrating the surface. If depressions are formed they shall be filled with the smaller stones of suitable grade and not with screenings. During the progress of the work the screenings will disappear in places, when more screenings must be added and the rolling and sprinkling continued until the road has a uniformly hard and even surface, and everywhere conforms to the proposed grade and cross-section of the road.

Applying Binder.—Screenings used for binder in both courses shall not be dumped in piles on the loose stones but rather dumped on the shoulders and carefully spread on the road by hand, care being taken that the screenings be placed on the road evenly mixed. This is best accomplished by casting lengthwise of the road rather than crosswise. Provided, however, that automatic spreading wagons may be used if an even spread can be obtained by their use.

Manner of Rolling.—Rolling shall at all times begin at the sides of the road, rolling lengthwise but working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.

Approved February 1st, 1912.

TOWNSEND A. ELY,
State Highway Commissioner.

SPECIFICATIONS USED BY BERRIEN COUNTY FOR CONCRETE ROADS, CLASS F.

WORK TO BE DONE.

1. The work to be done under this contract consists of the furnishing of all labor, tools, materials and machinery required to grade, prepare road bed and construct a concrete pavement with gravel shoulders on the above road as herein specified and perform all other work necessary for the proper fulfillment of the contract according to the meaning and intent of the plans and specifications, which plans are on file in the office of the county clerk, and are made a part hereof.
2. The contractor will be required to do all the clearing and grubbing, all excavations and embankments, all leveling, ditching, grading and surfacing and to furnish all material and labor for the same. He will be required to build all waterways and drains, and to clear away all rubbish which may obstruct the roadways or waterways.
3. The whole work must be conducted and completed in a thorough and workmanlike manner in accordance with the plans and specifications, and under the supervision of the County Board of Road Commissioners.

GRADING.

1. The term "Grading" shall include all cuts, widening of fills, ditches, drains, borrow pits, approaches and all dirt moving, for whatever purpose connected with the work, where such work is an essential part of, or necessary to, the prosecution of the contract. It shall also include, unless otherwise specified, all necessary grubbing, clearing and disposing of wood or stumps, or removing of fences or other obstructions from the work.
2. Where the grade of the present roadbed is satisfactory to the engineer, the contractor will only be required to make such roadbed smooth and even to comply with the grade stakes established by the engineer.
3. Stakes will be set by the engineer in charge, for center line, side of slopes, surface grade and other necessary points, properly marked for cut or fill.
4. When grade line is approached, final grade stakes will be set, for which sufficient notice must be given to the engineer in charge. Contractors will not be allowed for excavation beyond stakes set nor below grade unless such additional work becomes necessary, and is authorized by the engineer in charge in writing.
5. Material must be deposited as ordered by the engineer in charge, and any excess of dirt must be used in uniformly widening the roadbed or the adjoining fills, or in raising the grade line where necessary to provide for future settlement. All slopes must be properly dressed to lines given by the engineer in charge.
6. The county reserves the right to increase the excavation at any point by changing the grade line or widening the roadway, and such



Laying Concrete in Berrien County. The cuts show manner of laying, striking off the surface with properly crowned templates and floating the surface with a wooden float. Note that the floating is done from a bridge formed of plank so as not to disturb the fresh concrete.

one hundred feet apart in retentive soils and must be filled with coarse gravel when the first layer of metal is being applied.

Metal Bed and Shoulders.—After the road has been graded as above described the metal bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material, will be placed on each side of the metal bed, not less than nine feet apart, or such greater distance as may be required to retain the width of metal specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center or if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-grade.—After the shoulders and metal bed have been formed as above described, the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition, everywhere parallel to the finished roadway, the metal bed being seven inches below the finished grade and having the same crown. In deep, mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, rotten straw or fine brush shall be laid on the sub-grade to prevent first course of gravel mixing with the sand.

Gravel Bottom.—After the road has been graded and rolled in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than four inches deep after compacting, five inches loose measure.

The gravel for this course shall consist of good, clean bank gravel, not less than sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two and one-half inch mesh. If clay gravel is used it should contain only clay enough to coat the pebbles, no free lumps. In no case shall the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities. The gravel course shall then be harrowed with a spike-tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any hollows that may develop in this course of gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniform and hard and everywhere parallel to and three inches below the surface of the finished road.

The crown can be preserved during construction by the occasional use of the grader or other suitable floating tools.

ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

Slag Bottom.—If slag is used, a layer of crushed slag of an approved quality shall be spread on the prepared bed to such uniform thickness as will make not less than four inches after thorough rolling, five inches deep loose measure. The slag shall consist only of that part of the

consistency in a concrete batch mixer of an improved type and the mixing shall continue until the cement is uniformly distributed and the concrete is uniform in color and homogeneous.

Retempering.—Retempering, that is remixing with additional water, concrete that is partially hardened will not be permitted.

PROPORTIONS.

The concrete shall be mixed in a proportion of one (1) sack of Portland cement, two (2) cubic feet of fine aggregate and four (4) cubic feet of coarse aggregate.

Consistency.—The material shall be mixed wet enough to produce a concrete of a consistency that will flush readily under light tamping.

DEPOSITING CONCRETE.

Upon the properly rolled and drained sub-grade shall be deposited seven (7") inches of the hereinbefore specified concrete. The concrete shall be deposited in strips extending across the full width of the area paved and shall be deposited as soon after mixing as is practical, but in no case shall more than thirty (30) minutes elapse between the mixing and depositing of the concrete.

EXPANSION JOINTS.

Three-eighths ($\frac{3}{8}$ ") inch joints shall be placed across the roadway at intervals of twenty-five (25') feet, perpendicular to the center line. All expansion joints shall extend through the entire thickness of the pavement. The expansion joints shall be filled with a suitable elastic, water-proof compound that will not become soft and run out in warm weather or hard and brittle and chip out in cold weather. The concrete at expansion joints shall be protected with metal. The type of metal plate used shall be that known as Bakers Plates or some design equally as satisfactory to the authorized representative of the board.

FINISHING.

After the concrete has been brought to the required grade by means of a suitable templet, the surface shall be worked with a wood float in such a manner as to thoroughly compact it and to produce a smooth, plain surface. Before the concrete surface is thoroughly hardened, it shall be slightly roughened by brushing with a stiff vegetable fibre brush or broom. On grades of over five percent the surface shall be corrugated if directed by the engineer.

PROTECTION.

After finishing the surface shall be kept well sprinkled with water, and as soon as the concrete has hardened sufficiently, the surface of the pavement shall be covered with a thin layer of ordinary dirt which shall be kept wet for at least five days by sprinkling with water. Under the most favorable conditions for hardening, in hot, dry weather, the pavement shall be protected from traffic for at least seven days and in cool, damp weather, for an additional length of time to be determined by the engineer.

GRAVEL SHOULDERS.

After the concrete has set and the earth blanket has been removed, the gravel shoulders shall be constructed as shown on the plans of a first class grade of road gravel which will compact under rolling with a five (5) ton roller or by a suitable method of hand tamping, and said gravel shall not contain in excess of twenty (20%) percent clay.

GENERAL INFORMATION RELATIVE TO THE COUNTY ROAD SYSTEM.

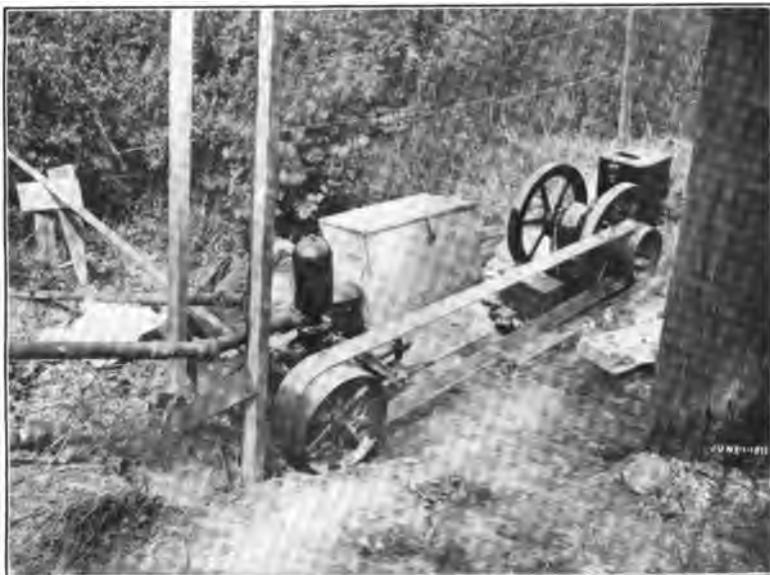
Both the construction and maintenance of good roads has been and is being carried on very successfully by the various townships in the state under the direction and supervision of the township boards and highway commissioners, but it was evident for a number of years that a unit of control larger than the township was necessary, and in 1893, the law, providing for the county system of building highways, was enacted by the Legislature. It is now a well demonstrated fact that road affairs are best administered by a board of county road commissioners, appointed in the first instance by the board of supervisors and finally elected by the people. When a township fails to successfully build a state reward road, it is sometimes on account of a shortage of funds, but more often on account of lack of competent management and skilled engineers or expert supervision. The first mile of road built either under the township or county plan usually costs more than any succeeding mile. A township commissioner holds office for only one year and during this time he may learn something about highway construction and can usually save more money to a township in subsequent years than any man who might be elected to fill his place. Yet, as soon as a township commissioner has become proficient, he is out of office and a new man must learn the work at the expense of the township and many times makes the same mistakes as his predecessor. Under the county system, the board of county road commissioners is a permanent body, having been elected for six years, one member retiring every two years. At all times, under ordinary circumstances, at least two members of the board are men who have had experience in the actual administration of county road affairs, and mistakes once corrected are not likely to recur.

Object.—The fundamental object of the county system is to build trunk line roads between the principal market towns and along lines of greatest traffic. Usually, when a county adopts the county system, the commissioners lay out a system of highways distributed over the county and work on this system until completed. In most instances, at the present time, only a few miles can be built each year, but, eventually, a system of highways is built up, covering the entire county and connecting with the main arteries of travel of other counties. The county system improves and maintains the principal lines of heavy traffic, leaving the less important roads to be built and maintained by the individual township, the same as before the county road law was adopted. For this reason, the townships receive a direct benefit from the county plan in that they are not obliged to maintain the road taken over by the county

road commissioners. "The county road system opens up the main highways, arteries of trade, gives opportunity for making good roads where good roads are needed. It leads to a more judicious expenditure of money and puts the expenditure into more competent hands."

Ways and Means.—In order to secure the county road system, it is necessary to first do one of two things: Secure the signatures of ten percent of the resident freeholders in each organized township, incorporated village and city, as shown by the tax roll of the preceding year, present the same to the board of supervisors, who, if a majority are in favor of the same, may submit the question to a vote of the electors, either at a general or a special election to be held not less than three weeks after the adoption of the resolution; or, second, the board of supervisors may submit the question to a vote of the electors without a petition, providing a majority of the members vote therefor. When the votes are canvassed, if it appears that a majority of the electors voting have voted favorably, the county road system becomes operative in such county. The first Monday in April is made a general election for this purpose.

In any county where the county system may be adopted, a board of county road commissioners shall be appointed by the board of supervisors or elected by the people at a general or special election called for that purpose. Commissioners who are appointed by the board of supervisors hold office only until the first day of May in any odd year, the year in which a regular session of the Legislature is held. This change was made in the old law, in order that counties would not be compelled to hold an election for the sole purpose of electing a county road commissioner at a time when no other county or state election was to be held. One commissioner is elected for two years, one for four years and one for six years. Thereafter, on the first Monday in April in each odd year, a county road commissioner shall be elected for a full term of six years. In Wayne and Mason counties, the commissioners are elected at the regular election in the fall, but take office at the same time commissioners do who are elected in the spring, May first. In counties, which have more than thirty surveyed townships, the board of supervisors appoint the county road commissioners. A member of the board of supervisors is not eligible for appointment as a member of the board of county road commissioners. No member of the board of county road commissioners shall in any way be pecuniarily interested in any contract entered into or work carried on by or for such board. County commissioners cannot employ one of their own number and pay him out of the county road fund, but it should be understood that section 10 of the county road law does not prohibit a county road commissioner from superintending county road work in the exercise of his official duties, and his salary is paid in the same manner as any other county officer. The salary of the county road commissioners is fixed by the board of supervisors. The board of county road commissioners may lay out, grade, drain or construct any road under its jurisdiction. They may also construct bridges and culverts, and have all the powers and duties usually conferred upon township highway commissioners. The board has the right of condemnation for the purposes of right of way for roads, but cannot condemn gravel pits or land for road purposes outside of right of way. They may maintain in their own name action



Wayne County Road Commissioners say:

"Water in sufficient quantities to meet our requirements is not often available in the country districts without some device for carrying it. Hauling it by teams at \$5.00 per day is an expensive proposition, especially where a single crew, when under full swing uses about 15,000 gallons a day. To meet this situation pipe lines are laid to the nearest supply, which lines, where they run along our work, are tapped every 300 feet so that a supply may be available at any point. Three horse power gasoline engines are used to force it to the work. In the illustration above water is being taken from the River Rouge for use on Michigan Avenue Road. We have pumped water out of the River Rouge a distance of six miles. At least eight teams would have been necessary to do the same work."

for injury to any county road under their control; damages received in this manner are credited to the county road fund.

On or before the first day of October in each year, the board of county road commissioners must determine the work to be done and the amount of county road tax necessary for the ensuing year, specifying in such determination the roads or parts of roads to be improved and the money necessary for each particular piece of road, the amounts necessary for extra tools, machinery, current expenses, etc. The board of supervisors have power to reject any or all items, or alter such items as they may determine or they may refuse to levy any county tax to be used for the construction of county roads and it is not lawful for any board of county road commissioners to spend any moneys on any roads not specified in the final determination of the board of supervisors, or for any purpose not authorized by the board of supervisors. It is, however, incumbent upon the supervisors to levy sufficient county road tax to keep roads already built by the county in repair. All taxes for county road purposes are levied and collected in the same manner as other county taxes and are paid out by the county treasurer on warrants of the chairman of the board of county road commissioners, countersigned by the county clerk, who is clerk of the board. Such tax must be kept separate from all other taxes by the county treasurer. Taxes for county road purposes cannot exceed:

- (a) A three mill tax in counties having an assessed valuation of less than \$20,000,000.
- (b) A two mill tax in counties having an assessed valuation of more than \$20,000,000 and not exceeding \$50,000,000.
- (c) A one mill tax in counties having an assessed valuation of more than \$50,000,000 and not exceeding \$100,000,000.
- (d) A one-half mill tax in counties having a valuation of more than \$100,000,000.

County Roads.—County roads are certain roads adopted as such by the board of county road commissioners and must lie wholly and entirely outside of the corporate limits of cities. Any streets of an incorporated village may become a county road and participate in the county road fund, providing they are adopted by the board of county road commissioners, with the authority of such village, but such county roads cannot receive state reward on that part of any county road within the corporate limits of such village.

The proceedings necessary for the board of county road commissioners to acquire control of any street or public highway are that a yea and nay vote upon the adoption of any road or street shall be taken by the commissioners and notice of favorable determination shall be served upon the highway commissioners of the township in which such road lies, or upon the highway authorities of any village and published once a week for three successive weeks in a newspaper printed and circulated in the county. Proof of service and publication to be by affidavit. Sole jurisdiction and control over such roads is now vested in the board of county road commissioners and townships and villages are entirely relieved from their care and maintenance. Boards of county road commissioners of adjoining counties may unite in laying out and constructing a county road on a county line.

Discontinuance of County Roads.—Proceedings for the discontinuation or abandonment of any county road, or any part thereof, are the same as for the adoption.

Methods of Doing County Work.—Where a proposed expenditure is greater than five hundred dollars for building, rebuilding or repairing of roads and bridges, the board of county road commissioners must advertise for bids, but have the right to reject any and all bids and do the work by day labor and purchase materials therefor, but must file plans, specifications, bids and reasons for not letting by contract, with the county clerk.

State Reward For County Roads.—Counties participate in the state reward for roads the same as townships, as follows:

Class A, sand-clay.....	\$250 per mile.
Class B, gravel	500 per mile.
Class C, gravel-stone.....	750 per mile.
Class D, stone-gravel.....	750 per mile.
Class E, macadam.....	1,000 per mile.
Class F, concrete	1,000 per mile.

Township Roads.—Townships in counties under the county system ~~may~~ build roads the same as before the adoption of the county road plan and receive the state reward, but cannot bond and draw back their county road tax as formerly.

Counties Not Compelled to Build State Reward Roads.—Counties under the county road system do not necessarily have to build state reward roads but may improve county roads in any manner that seems best, but most counties prefer to build state reward roads, as this reward is a considerable item of revenue.

The following cut shows the state map with counties which ~~have~~ adopted the county road system in *white*.

White Counties Have Adopted County Road System

SYNOPSIS OF LECTURE ON COUNTY ROAD SYSTEM.

GIVEN BY FRANK F. ROGERS, DEPUTY STATE HIGHWAY COMMISSIONER, AT FARMERS' INSTITUTES AND PUBLIC ROAD MEETINGS.

In Michigan the so-called "County road system" is merely a plan by which the leading or main traveled highways of a county are placed in charge of a commission and improved by means of a tax levied on all the assessable property within the county. Thus, the city property and village property as well as the farm property, real and personal, pays its pro rata share of the tax and contributes in an equitable manner towards an improvement which benefits every member of the community. That such a tax is just for, and is willingly paid by the residents of cities is clearly shown by their large personal donations for good roads and the large urban majorities given in favor of the county plan whenever this question is brought before the electors of a county. No intelligent citizen questions the fact that cities and villages prosper in a direct ratio to the facilities offered for getting into and out of them with all kinds of vehicles and all kinds of loads in all kinds of weather and at all seasons of the year.

The county road system is a "local option" measure and cannot be forced on a community against its will. The board of supervisors of any county, not under the county system either by petition or without, by a majority vote at any regular or special session resolves to submit the question of adopting this system to the voters of the county, which question may be voted on at any regular election that may be designated, or at a special election called for that purpose.

If, at such election, the majority of the voters favor the county system, the board of supervisors then has the power to appoint three county road commissioners who will hold office until their successors are elected at the general spring election in a year in which the legislature meets, viz.: the odd years. The commissioners, to be elected will be elected for two, four and six year terms, respectively and thereafter one new commissioner will be elected every two years. The newly elected commissioners take their offices on the first day of May following the election.

The board of county road commissioners has the power to take over such roads as it sees fit and constitute them as county roads. Such roads thereafter become a county charge and remain such unless the board sees fit to turn them back to the township, a thing that is almost never done. All roads in the several townships, not thus made county roads remain a township charge and are cared for by the township officers as heretofore.

Before any county roads are improved the commissioners must report to the board of supervisors at its October session, showing the particular roads or parts of roads they propose to improve and just how much money they propose to expend on each particular road or parts of roads. If the board of supervisors approves the action of the commissioners, it may then vote the tax levy asked for. If not, they



D. A. Brotherton, Engineer, Board County Road Commissioners, Delta County, furnished the pictures on this page and writes as follows:

"Enclosed find two views of the new bridge built last year at Wells on the Bay Shore Road over the Escanaba River.

"The Board of County Road Commissioners had \$40,000 with which to construct a bridge. Most of the bridge builders claimed we could not build it for less than \$60,000. I informed them all that Delta County had no money to spend for frills or banquets, but wanted \$40,000 of concrete and steel put in such shape as to safely carry traffic over the Escanaba River and that they would have to get 'down to brass tacks.'

"As engineer for the Board I drew up an outline of what I considered we should get, specifying the requirements we would insist on and this bridge is the result.

"While it is somewhat plain, it is well proportioned and presents a neat, substantial and very good appearance. Both the steel and concrete are so proportioned and placed as to make the most economical construction and there is no waste material, that is no material which adds weight without having its specific use in caring for some particular strains.

"The bridge is 840 feet in length, divided into 21 40-foot spans. Two expansion joints allow for expansion and contraction. The south end crosses overhead the Escanaba & Lake Superior R. R. at an angle making it necessary to build two piers on a skew of 30°. The west end of the piers were left 40 feet centers, throwing the east ends to the south about 10 feet. You will notice in one of the views the consequent lengthening of span on one side and increased depth of that girder.

"The south approach is on a 6½% grade and the bridge north of the span over the E. & L. S. Railroad descends on a 2.11½% grade."

may reject it in whole or in part. The tax levy, however, cannot exceed fifty cents on each thousand dollars of valuation in counties assessed for more than one hundred million; one dollar on each thousand dollars of valuation in the counties assessed at between fifty and one hundred million; two dollars on the thousand dollars of valuation in counties assessed at between twenty and fifty millions and three dollars on the thousand dollars of valuation in counties assessed at less than twenty millions as shown by the tax rolls of the last preceding year.

Up to date September 1, 1912, 46 of the 83 counties of Michigan had adopted the county system and 30 of them have actually got to working under it. At the October session of the board of supervisors it was voted to submit the question of adopting the county system in nine more counties, and at the January session four more boards acted favorably on the same proposition. Nine of these adopted the system at the April election of this year.

SEVEN REASONS.

In summing up this question it occurs to the speaker that there are seven good reasons for working under the county road system, any one of which is weighty enough to warrant its adoption:

1. It is an equitable plan, spreading the cost of constructing main roads over all the taxable property in the county.
2. It tends to make continuous main roads with no breaks at the township lines. This desirable feature is never attained under the township plan, while town line roads invariably suffer.
3. Money enough is secured to improve difficult pieces of road that could never be touched under town supervision. Many striking examples of this might be noted in such counties as Kalamazoo, Manistee and Wexford.
4. Under the county plan there are always two experienced men on the board. This tends to retain skilled employees in their positions, and it is true that county roads as a rule, are distinguishable by their superior workmanlike features.
5. The county plan tends to economy in the matter of road building equipment. One county in Michigan not working under the county system, has six steam rollers and five rock crushers, all owned by townships. Under county supervision this machinery could do several times as much work as it now performs, to say nothing about the saving in first cost and up-keep.
6. It is satisfactory, for no county that ever adopted the county plan and actually built roads under it has abandoned it, although it could do so as easily as the system was adopted in the first instance.
7. It gets the roads. Saginaw county has built more than 100 miles of road under this system in the past nine years. No county in the state can show so much road built by townships in so short a time. This county has funds enough available to build 40 miles of macadam road in 1912. During the first five years of the state highway department, 20 counties working under the county system, earned 55 per cent of all the money paid out as state rewards.

The writer is firmly convinced that the county system supplemented by state reward offers to the rural communities the most economical solution of Michigan's road problem.

REINFORCED CONCRETE BRIDGE FLOORS.

BY L. C. SMITH, ENGINEER.

The Michigan State law provides that: "All bridges shall have a clear roadway of at least sixteen feet and shall be capable of carrying a ten ton moving load." In another place, it provides: "There shall be no bridge, culvert or artificial roadway of any kind constructed in any public highways of this state over any water course thereof having a roadway of less than sixteen feet in width, and the same shall be built of sufficient strength to safely carry a ten ton load."

These two sections provide practically the same thing, except that in the last section the word "moving" is omitted, which is, of course, fatal to the design of a bridge greater than ten foot span.

The law, as seen above, provides for a ten ton moving load, and the traction engines which are sold in this state and used here vary in weight from nine to eighteen tons, the larger percent being heavier than ten tons, when allowance is made for coal, water and engineer. It can be readily seen that for township, county and village officers to properly protect themselves against damage suit, they must build bridges which will safely carry a ten ton traction engine, at least, and it does not take much forethought to see that with the heavier engines, which are being made, the required carrying capacity of bridges will be increased to fifteen tons. The up-to-date bridge engineer designs all bridges to carry at least a fifteen ton traction engine or road roller.

The Michigan State Highway Department called for reports from the township highway commissioners and county drain commissioners, to give the amounts expended on bridges for the year of 1909. Ninety-seven percent of the highway commissioners reported an expenditure of \$613,191.94; twenty-nine of the sixty-three county drain commissioners reported an expenditure of \$52,206.78, making a total amount reported of \$665,398.72, and estimating those who failed or refused to report in the same proportion, we have a total expenditure of three-fourths of a million dollars for bridges and culverts. Nearly a quarter of a million of this was spent for wood and metal culverts and short span steel bridges with wood floors, which will have to be repaired within five years at the outside and more than likely will have to be totally replaced in fifteen years.

On account of the increased cost of oak planking, more or heavier traffic, shaky condition of old floors, the question of devising a permanent comparatively inexpensive country bridge floor has become important. Many fairly good long span steel and wrought iron highway bridges are going to pieces on account of no attention in regard to painting foundations, and rigid floors.

Township, village and county officials have resorted to their old "consulting engineer," the bridge agent. They have been told that their bridges are not heavy enough to carry concrete floors (meaning steel jack arches and seven or eight inch plain concrete floors). It falls to



Concrete floor on Delta bridge over Grand River, laid in accordance with specifications given.

The upper cut shows the completed floor, with planks along the sides for the purpose of holding snow in winter.

The lower cut shows that the steel joists are all below the floor except the upper flange, to which the floor is clinched.

the engineer in general practice to investigate these old trusses and recommend, if possible, a form of floor which will be adaptable. Out of ten or twelve bridges, which have been investigated with an eye to putting on a thin reinforced concrete floor, only four or five have shown sufficient strength of member to carry safely such floor.

In examining an old bridge, the following points should be taken into consideration:

- (1) Stability of foundations and piers.
- (2) Rusting or damaged members.
- (3) Pin packing and floor beam connections.
- (4) Size of all members.

In nearly every case, it is found that stone abutments and piers need repointing at least, and in many cases, old lime mortar is washed out entirely. Facing walls must be built where old stone walls are in very bad repair. Only the best Portland cement mortar should be used in repointing.

The writer has observed, by use of transit, center piers made of two four-foot steel tubes filled with concrete sway two or two and one-half inches when a light wagon crossed the bridge. Such conditions are caused by poor footings, oftentimes containing no piling and light bracing poorly tightened up. They can be stiffened up by tightening bracing and, where needed, building concrete footings, ramming concrete under tubes if water can be lowered sufficiently.

Steel tubes have come into disrepute on account of faulty workmanship and dodging of specifications by contractors rather than on account of poor design. For highway work, tubes of large enough size set on piling under water and filled with good concrete are serviceable.

Oftentimes, old wood floors and dirt have held the water on the base of main members until they are rendered unsafe for any kind of use. Many times, members are found which have been bent or contorted by ice jams and straightened, making them unfit for carrying load. In case of a pair of eye bars in the lower chord, one may be bent or twisted until it carries the whole load. In such case, members must be replaced.

The packing of pins should be noted and checked up to see if the least moment is obtained and if pins are large enough.

Floor beam connections are together the most important and poorest detail in highway bridge construction. U. stirrup hangers are used largely and, even when properly designed for size, are shaky and dependent upon threads for holding. These connections are subject to more rust than any other joints. Eye plates, firmly riveted to the floor beams, are the only sane connections.

In no case have I found an old bridge which had a floor system which would figure out to safely carry a ten ton moving load with a factor of safety of four. Floor beams are sometimes not heavy enough to carry without reinforcing with new heavy cover plate on bottom flange.

Usually, wooden stringers are found and, in case where steel stringers are in, they are seldom more than five or six inch I-beams on a twelve and one-half or thirteen foot span. In every case where I have recommended a concrete floor, it has been necessary to put in new steel stringers.

All truss members must be measured up and checked, making allowance for loss in cross-section, due to rust.

There are some good well preserved wrought iron bridges in this state, built both Pratt truss and Whipple double intersection type. These bridges figure out for carrying capacity better than some of the more modern steel bridges, which are being "dickered for" by local authorities today.

This plan has been followed for assumed load specifications and computing stress in truss.

(1) Concentrated wheel load of five tons on area twelve inches by twenty-eight inches on floor slab.

(2) Concentrated wheel load plus weight of slab on two stringers spaced not more than twenty-eight inches apart.

(3) Distributed ten ton load plus dead floor load on floor beams.

(4) Ten ton concentrated load tried on each panel joint plus dead load of whole bridge for the trusses.

In no case have concrete floors been recommended where the stress in the steel would be above seventeen thousand pounds, and in wrought iron above thirteen thousand pounds.

GENERAL SPECIFICATIONS.

Steel.—Steel stringers shall be spaced not more than twenty-eight inches nor less than twenty-four inches centers.

For panel lengths, from twelve and one-half feet to fourteen feet and width of roadway sixteen to eighteen feet. Eight-inch eighteen pound I-beams shall be used for three center stringers. On each side of these, two seven-inch fifteen pound I-beams and, in place of side channels, six inch twelve and one-quarter pound I-beams shall be used at each edge. All stringers shall be long enough to reach two panel lengths, and be laid so as to break joints. Stringers shall be bolted to floor beams securely with one-half inch bolts at each intersection. Stringers shall be connected at ends with two three-eighths inch fish plates fourteen inches long and wide enough to fit snugly between flanges. Fish plates shall be bolted with eight one-half inch bolts in each plate. Not more than one-quarter inch not less than one-eighth inch shall be allowed between ends of stringers.

All abutment and pier ends of stringers shall be bedded in Portland cement mortar mixed 1-3.

All floor beams, sway bracing stringers and connections shall be coated with two coats of linseed oil paint. Tops of stringers must not be painted.

Forms.—Forms shall be placed between stringers tight up under top flange. Tar or building paper must be used on forms to make them tight.

Curb forms shall be securely fastened in place before any concrete is placed.

Reinforcing.—Expanded metal No. 40—3" U. S. or Kahn rib metal No. 3 wire reinforcement, having the same area of cross-section per foot width, shall be used. Reinforcing shall be laid with main members, running at right angles to stringers. Ends of reinforcing shall be bent up three inches into curb. Strips shall be securely wired or clipped together. Reinforcing shall rest on top flange of stringers and

be not more than one-half inch nor less than one-quarter inch from forms.

Concrete.—Gravel shall be from forty to sixty percent pebbles by weight, no stones larger than one-inch. An approved brand of Portland cement shall be used. Concrete shall be mixed in the proportion of one part cement to three parts gravel, wet mix. A batch mixer or very careful hand mixing shall be used.

Concrete shall be spread uniformly three and one-half inches thick over tops of stringers. On account of stringers being of different depths, finished roadway will be crowned two inches.

Concrete must not be trowelled, but smoothed off with a template. Curbs must be poured at same time as roadway.

Expansion Joints.—On top of every other floor beam, an expansion joint shall be placed. This joint shall consist of two thicknesses of heavy tar paper.

Work shall not stop in laying the floor at any place except at an expansion joint.

Surface shall be covered with sand or saw-dust and be kept wet during first five days of drying.

Forms shall not be removed in less than three weeks. No traffic shall be allowed on floor until four weeks after completion of concrete work.

Tar Top.—A skin coat of bituminous binder, mixed with sand, shall be spread on the concrete surface not to exceed one-quarter inch in thickness.

A bridge floor was replaced at Montrose, Michigan, following the above plan. The cost of doing that work was as follows:

COST OF MONTROSE BRIDGE 150 FOOT SPAN, 16 FOOT ROADWAY.

1. New 8" steel stringers	\$595 00
2. Removing old floor	15 00
3. Punching and erecting new steel.....	60 00
4. Lumber for concrete forms	65 13
5. Labor placing forms	10 00
6. Cement on the job	90 00
7. Gravel on the job, 1/2 mile haul.....	18 00
8. Mixing and laying concrete	70 00
9. 2,400 square ft. expended metal.....	112 90
	<hr/>
	\$1,035 03

No superintendence is allowed for.

ITEMIZED COST OF CONCRETE PER CUBIC YARD.

1. Form lumber	\$2 19 per cu. yd.
2. Labor on forms	34 per cu. yd.
3. Cement 1-3 mix.....	3 03 per cu. yd.
4. Gravel	60 per cu. yd.
5. Mixing and laying	2 36 per cu. yd.
	<hr/>
Total	\$8 52 per cu. yd.

New oak floor would cost fifty dollars per thousand, including laying, or for a wood floor three inches thick, the cost would have been fifteen cents per square foot, or three hundred sixty dollars. To this, must be added the steel stringers needed in either floor, which makes \$360 plus \$595, or \$955. The difference in cost of the two floors would only be \$80, without any consideration of the most important item, namely: How long will it last? The concrete floor will continue to grow stronger with age and on the other hand, the wooden floor would need repairs in five years. The concrete would tend to stiffen the whole bridge and distribute the concentrated loads over a larger area, and the wood floor is at best a springy, shaky, rough riding and expensive proposition. An ordinary plank bridge floor weighs about thirty pounds per square foot, while the concrete floor weighs sixty pounds per square foot, both weights including steel stringers.

When a new bridge floor for an old steel or wrought iron bridge is needed, a competent bridge engineer should inspect the trusses and abutments and determine whether or not the bridge is sufficiently strong to carry a concrete floor. If the bridge is worth it or can be reinforced to make it sufficient to carry a reinforced concrete floor, it is by far the best.



View of concrete culvert constructed in Wayne County.

Good reinforced concrete bridges and culverts are an important part of good roads construction. Wayne County's engineers have designed standard plans for culverts for use all over the county.

STATE HIGHWAY COMMISSIONER MADE REFEREE ON INTER-COUNTY DRAINS.

Act Number 185 of the Public Acts of 1911, amended the drainage laws of this State so as to make the State Highway Commissioner arbitrator on drains affecting more than one county, whenever the county drain commissioners cannot agree, as follows:

"Provided, That should the said county drain commissioner be unable to agree as to the *necessity, location or benefit* of such drain, or *any other matter relative thereto*, they, or either of them, may appeal to the State Highway Commissioner, who shall act in the premises as hereinafter provided. Such State Highway Commissioner shall be furnished with all of the data relative to such drain which shall be in the possession of such county drain commissioner, or either of them, and said highway commissioner shall have the right to subpoena witnesses and take testimony, and his decision relative to such matters as shall be in dispute shall be final." (Part of Section 2, Chapter VII, Public Acts No. 185.)

Section 3, of the same chapter, further provides:

"That if said county drain commissioners cannot agree and determine the just percent of the cost of construction that each county shall bear, then either or all of said commissioners may appeal to the State Highway Commissioner, who shall act in the premises, and he shall have the power to determine said percent for them, and his decision of the just percent shall be final."

Acting under the above provisions, Daniel E. Birdsall, County Drain Commissioner of Barry county, petitioned the State Highway Commissioner on the 24th day of November, 1911, asking him to determine the necessity and route of a proposed drain, known as the "Little Thornapple Drain," which affects the counties of Barry, Ionia and Kent.

The first hearing was held by Deputy State Highway Commissioner, Frank F. Rogers, on December 20th, 1911, and the two following days were spent in looking over the route of said proposed drain, which covered a distance of about twelve miles.

A second hearing, for the purpose of listening to arguments for and against said drain, was held at the court house in Hastings on January 24th, 1912, and on February 5th following, a decision was rendered favoring the construction of such drain.

On the 29th day of April, 1912, L. C. Williams, County Drain Commissioner of Calhoun county, applied to the State Highway Commissioner, asking him to determine the just percent that each county should bear of the cost of constructing the "State and Indian Creek Drain," affecting Calhoun and Eaton counties.

On the 11th day of May, 1912, a preliminary meeting was held at the office of County Drain Commissioner Williams, in Hastings. On the 24th day of May, Deputy State Highway Commissioner Rogers

examined the course of the proposed drain, some fourteen miles, in company with the county drain commissioners of Calhoun and Eaton counties, and on June 13th, a decision was rendered, apportioning ninety-five percent of the cost of said drain to Calhoun county and five percent of the cost to Eaton county.

In addition to the above, advice was given to the county drain commissioners of Lenawee and Monroe counties, concerning the best methods of strengthening, or underpinning the abutments of several old bridges, which were to be endangered by the proposed deepening of the Macon drain to a level below the footings of said abutments. The Department's advice was accepted and acted upon in this case.

Altogether, this work consumed about three weeks time of the Deputy State Highway Commissioner, and such work is likely to increase and demand more of the Department's time as the public becomes more familiar with the provisions of this act.

STATE HIGHWAY COMMISSIONER.

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TABLE NO. 11. Showing the Official Tests of Michigan Rocks by the Office of Public Roads, Washington, D. C.

No.	Town or city.	County.	Name.	Weight (Pounds per cubic foot.)	Absorp- tion. (Pounds per cubic foot.)	Per cent of wear.	French coefficient of wear.	Hard- ness.	Tough- ness.	Cement- ing value.
1243	Grand Island	Algoma	Dolomitic sandstone	159	0.45	5.2	7.8	17.3	7	20
1633	Eben	do	Silurian dolomite	168	1.88	5.7	7.1	10.2	5	39
2216	Rock River Township	Alpena	Limestone	159	3.92	7.2	5.6	12.1	7	34
1584	Alpena	Armenia	do	165	1.55	7.9	12.1	14.3	8	53
2105	Whitney	Charlevoix	do	165	1.19	3.3	0.0	0.0	4	66
5004	Charlevoix	Chippewa	do	147	4.24	9.9	1.35	1.35	4	9
2318	St. Mary's River	do	Altered slate	172	1.09	1.09	1.09	1.09	1.09	35
2210	Wells Township	Delta	Altered sandstone	168	1.59	3.7	10.9	16.0	11	14
1848	Wells Township	do	Limestone	168	1.00	3.4	11.6	16.5	12	58
1846	do	do	Dolomite	175	1.39	4.3	9.4	12.5	10	60
1621	Breitung Township	Dickinson	Ferruginous slate	209	1.44	4.6	8.6	17.2	8	9
1622	Iron Mountain	do	Dolomite	178	1.40	4.6	7.8	12.5	25	25
1741	do	do	Ferruginous slate	196	1.09	5.2	18.5	1.09	7	13
1762	do	do	(Gneissic) granite	165	1.53	4.2	8.4	13.5	50	50
2008	Iron Mountain	do	Ferruginous sandstone	190	1.32	4.9	10.4	12.5	30	30
2903	do	do	Altered dolomite	184	1.37	3.9	12.5	18.1	29	28
2611	do	do	Amphibolite	181	.54	3.2	1.2	1.2	10	2
2625	do	do	Ferruginous sandstone	203	1.69	6.7	7.0	11.6	16	27
2875	do	do	Quartzite	162	.61	3.5	1.16	1.16	1.16	33
5146	Bellvue	Eaton	Hornfelsed schist	190	.17	1.7	23.5	23.5	20	42
4520	do	do	Limestone	159	3.68	7.5	5.3	11.8	1.7	132
4521	Petoskey	Emmet	do	165	.86	4.7	8.5	16.3	11	183
1335	Elk Rapids	do	do	168	.84	3.2	12.3	13.0	11	66
4682	Petoskey	do	do	162	1.36	4.5	8.9	13.8	12	26
4854	do	do	do	165	1.58	5.1	7.8	14.5	12	85
5084	Bessemer	Geogebet	do	165	1.24	5.6	7.1	11.5	7	15
1131	Catamet	Houghton	do	159	2.34	8.3	4.8	18.8	13	12
1132	do	do	do	181	1.45	5.9	8.0	17.5	7	36
4153	Hancock	do	do	175	1.24	3.2	12.7	16.5	18	118
4075	do	do	do	181	.42	4.2	9.6	13.0	10	120
1287	Bay Port	Huron	do	184	2.12	2.6	15.6	18.1	12	49
1288	do	do	do	165	1.34	2.7	14.8	15.3	12	50
3767	Tort Austin	do	do	165	1.35	1.35	1.35	1.35	1.35	30
4027	do	do	do	190	7.6	5.3	0.0	0.0	0.0	17
4063	Bay Port	do	do	165	1.00	3.3	12.0	15.4	11	48
2081	Whitebreare	do	do	162	1.94	4.5	8.9	12.5	9	69
2548	do	do	do	165	1.84	5.9	6.7	13.3	6	62
1970	Jackson	do	do	162	2.13	5.6	7.2	12.7	5	52
1971	Jackson	do	do	168	3.08	9.5	4.2	10.7	5	105
3463	Keweenaw	(?)	do	164	.16	1.16	1.16	1.16	1.16	17

FOURTH BIENNIAL REPORT.

Results of laboratory tests on road-building materials classified according to location.

MICHIGAN.—Concluded.

No.	Town or city.	County.	Name.	Weight, (Pounds per cubic foot.)	Absorp- tion, (Pound per cubic foot.)	Per cent of wear.	French coefficient of wear.	Hard- ness.	Tough- ness.	Friction- ing value.
3507	Mandan	Keweenaw	Altered dolomite	178	.11	4.2	9.5	16.8	12	500+
3508	do	do	do	178	.22	5.1	7.8	12.3	6	500+
2493	Marquette	Lemire	Quartzite	165	.24	1.9	20.8	24	4	194
1133	Marquette	Marquette	Hornfelsed schist	184	.14	4.7	8.5	18.0	30	194
1685	do	do	Chloritized basalt	184	.37	2.1	18.9	17.2	23	38
1636	do	do	do	184	.24	2.5	15.9	17.2	22	38
1637	do	do	Ferruginous slate	175	.51	4.8	8.3	15.2	10	17
1675	Negaunee	do	Slate	175	.51	(¹)	16.8	12	7	58
1676	do	do	Altered dolomite	172	1.52	5.5	7.3	18.5	0	(¹)
1677	do	do	do	175	1.35	(¹)	9.8	16.3	20	143
2455	Marquette	do	Quartzite-schist	175	.33	4.1	9.8	16.3	13	129
2456	do	do	Hornfelsed schist	165	1.81	4.5	8.9	16.0	12	151
2646	do	do	Altered dolomite	187	.17	3.4	11.7	16.8	10	41
2698	Negaunee	do	do	181	.17	4.0	10.1	17.4	19	43
2625	Marquette	do	do	184	.38	3.7	10.8	17.2	19	43
2826	do	do	Quartzite	165	.07	3.3	12.1	(¹)	37	4
3060	do	do	Altered dolomite	187	.14	1.5	26.7	18.3	18	83
3188	do	do	Epidote chlorite-schist	181	.16	2.6	15.3	16.8	26	26
3189	do	do	Hornfelsed schist	190	.40	2.5	16.7	17.8	22	31
5030	do	do	Altered dolomite	184	.18	2.6	16.4	16.7	6	26
1621	do	do	Dolomite	162	3.46	6.0	6.6	10.1	14.4	6
3834	Monroe	do	do	165	2.89	4.0	10.1	14.4	20	24
3835	do	do	do	165	3.25	4.5	8.8	14.8	10	18
4655	Bedford	Iza	Dolomite	163	0.23	4.1	9.8	14.9	13	16
5003	do	do	Calcareous sandstone	165	.26	6.2	6.5	18.4	6	25
2406	Manistique	Schoenborn	Limestone	168	.32	4.5	8.3	15.8	6	26
2807	do	do	do	172	1.27	4.2	9.4	14.3	6	26
2808	do	do	do	175	1.00	2.7	14.9	16.7	12	27
2874	Wayne	do	Slate	168	1.81	23.4	1.7	(¹)	3	14
3254	Detroit River	do	Dolomitic	150	3.77	4.3	8.3	12.6	4	17
3255	Detroit	do	Limestone	168	1.87	5.4	7.4	13.3	9	34
4821	do	do	Blast-furnace slag	153	1.01	0.3	4.3	11.3	2	34

¹ Test not made.² Material furnished from a quarry or some place not within city or town limits, the name of which was not given to the Office of Public Roads when the sample was sent.

EXPLANATION OF RESULTS GIVEN IN THE TABLES.

RESISTANCE TO WEAR.

Resistance to wear is a special property in a rock, and although it depends to a large extent upon both the hardness and the toughness of the rock it is not an absolute function of these qualities.

The per cent of wear in the table refers to the dust and detritus below one-sixteenth of an inch in size worn off in the abrasion test. The test is made in the following manner: Eleven pounds (5 kg.) of broken rock between $1\frac{1}{4}$ and $2\frac{1}{2}$ inches in size, 50 pieces if possible, are placed in a cast-iron cylinder mounted diagonally on a shaft and slowly revolved 10,000 times.

The French coefficient of wear is obtained by dividing 40 by the per cent of wear. Thus a rock showing 4 per cent of wear has a French coefficient of wear of 10. The French engineers, who were the first to undertake road-material tests, adopted this method of recording results. They found that their best wearing rocks gave a coefficient equal to about 20. The number 20 was therefore adopted as a standard of excellence. In interpreting the results of this test a coefficient of wear below 8 is called low; from 8 to 13, medium; from 13 to 20, high; and above 20 very high. Rocks of very high resistance to wear are only suited for heavy traffic.

HARDNESS.

By hardness is meant the resistance of a rock to the grinding action of an abrasive agent like sand, and is tested as follows:

A core 1 inch in diameter, cut from the solid rock, is faced off and subjected to the grinding action of sand fed upon a revolving steel disk against which the test piece is held with a standard pressure. When the disk has made 1,000 revolutions the loss in weight of the sample is determined. In order to report these results on a definite scale which will be convenient the method has been adopted of subtracting one-third of the resulting loss in weight in grams from 20. Thus a rock losing 6 grams has a hardness of $20 - 6/3$ or 18. Experience has shown this to be the most convenient scale for reporting results. The results of this test are interpreted as follows: Below 14, rocks are called soft; from 14 to 17, medium; above 17, hard.

TOUGHNESS.

By toughness is meant the resistance a rock offers to fracture under impact; such, for instance, as the striking blow given by a shod horse. This property is tested in a specially designed machine built on the pile driver principle, by which a standard weight is dropped upon a specially prepared test piece until it breaks. The height in centi-

meters of the blow which causes the rupture of the test piece is used to represent the toughness of the specimen. Results of this test are interpreted so that those rocks which run below 13 are called low; from 13 to 19, medium; and above 19, high.

CEMENTING VALUE.

By cementing value is meant the binding power of the road material. Some rock dusts possess the quality of packing to a smooth, impervious mass of considerable tenacity, while others entirely lack this quality. Cementing value should not be confused with the property possessed by Portland cement, which causes it to set into a hard, stone-like mass when mixed with water. The cementation test is made as follows:

The rock sample is ground in an iron ball mill with sufficient water to form a stiff, fine grained paste. From this paste small briquettes 1 inch (25 mm.) in diameter and 1 inch high are molded under pressure. After thorough drying, the briquettes are tested under the impact of a small hammer which strikes a series of standard blows. The number of blows required to destroy the briquette is taken as a measure of the cementing value of the dust. Some rock dusts, when thoroughly dried into compact masses, immediately slake or disintegrate when immersed in water. It is considered that the tendency to act in this way is not a desirable characteristic of a road material, as it would lead to muddy conditions on the road surface after rains. The test is interpreted so that cementing values below 10 are called low; from 10 to 25, fair; from 25 to 75, good; from 75 to 100, very good; and above 100, excellent.

WEIGHT PER CUBIC FOOT.

The weight per cubic foot refers to the weight of the material in the form of a solid and not as broken stone.

Anyone having stone they desire to have tested for road building purposes should write to the Office of Public Roads, Washington, D. C., for necessary instructions as to how to proceed to secure such tests. This information will be cheerfully furnished by the officials in charge.

ASSESSED VALUATION AND HIGHWAY TAXES BY COUNTIES, 1911.

Townships.	Assessed valuation.	Road Repair tax.	Highway Improvement tax.	County road tax.	Total highway taxes.
Alcona.....	\$1,200,405 00	\$4,962 14	\$7,374 19		\$12,336 33
Alger.....	4,249,983 00	10,842 07	21,248 52		32,090 59
Allegan.....	26,015,146 00	37,052 87	55,231 03		92,283 90
Alpena.....	10,989,325 00	6,520 75	10,486 42	\$15,433 43	32,440 60
Antrim.....	5,367,305 00	13,999 11	25,374 91		39,874 02
Arenac.....	2,141,957 00	6,580 81	14,449 10		21,029 91
Baraga.....	3,570,668 00	15,707 78	13,961 57	5,453 61	35,122 96
Barry.....	14,460,830 00	23,705 40	20,045 67		43,751 07
Bay.....	28,549,665 00	11,114 17	20,483 94	56,055 44	87,653 55
Benzie.....	4,936,630 00	7,834 93	15,206 15		23,041 08
Berrien.....	28,324,131 00	26,537 04	35,874 29	56,866 21	119,277 54
Branch.....	19,580,910 00	23,867 20	19,740 97		43,608 17
Calhoun.....	44,412,934 00	20,161 28	34,969 03		55,130 31
Cass.....	15,434,672 00	20,176 46	18,614 75		38,791 21
Charlevoix.....	12,349,025 00	10,015 32	17,200 97		27,216 29
Cheboygan.....	6,591,095 00	14,987 24	16,976 62	13,394 71	45,358 57
Chippewa.....	11,724,306 00	15,517 48	12,134 57	20,908 42	57,650 47
Clare.....	3,800,577 00	8,394 87	15,997 94		24,392 81
Clinton.....	20,144,705 00	28,810 59	19,267 84		48,078 43
Crawford.....	1,858,371 00	4,547 91	7,509 11		12,057 02
Delta.....	9,540,352 00	16,393 70	18,757 33	28,148 80	63,299 83
Dickinson.....	14,800,533 00	10,452 13	14,811 84	30,003 41	55,267 38
Eaton.....	24,445,813 00	29,092 37	32,350 12		61,442 49
Emmet.....	7,925,924 00	12,076 75	13,739 31	23,773 27	49,589 33
Genesee.....	43,459,321 00	27,367 17	29,445 80	43,487 38	100,300 35
Gladwin.....	2,112,213 00	7,430 99	12,644 23	6,298 41	26,373 63
Gogebic.....	36,214,122 00	25,198 65	32,198 65	40,000 00	97,397 30
Grand Traverse.....	14,663,340 00	10,762 37	16,973 35	16,323 87	44,059 59
Gratiot.....	15,854,809 00	18,698 91	43,152 80		61,851 71
Hillsdale.....	22,065,005 00	33,321 67	22,709 03		56,030 70
Houghton.....	89,875,801 00	45,905 63	31,539 91	41,496 57	119,032 11
Huron.....	15,063,129 00	27,668 10	55,312 66		82,980 76
Ingham.....	32,824,386 00	26,247 37	15,954 96		42,202 33
Ionia.....	21,238,848 00	28,455 17	26,002 87		54,488 04
Ioseo.....	2,021,235 00	3,828 39	8,608 27	6,064 73	18,501 39
Iron.....	21,304,613 00	23,273 87	12,920 00	17,511 24	53,705 11
Isabella.....	9,888,206 00	17,704 97	34,062 57		51,767 54
Jackson.....	38,585,905 00	29,179 63	22,109 61		51,289 24
Kalamazoo.....	38,821,130 00	21,793 23	10,960 25	61,139 83	93,888 31
Kalkaska.....	3,861,744 00	8,501 26	9,828 21	14,407 34	32,736 81
Kent.....	115,852,975 00	47,490 84	53,632 83		101,123 67
Keweenaw.....	6,132,874 00	13,440 40			13,440 40
Lake.....	1,292,374 00	6,445 15	9,192 40		15,637 55
Leapecr.....	18,759,272 00	25,403 46	31,572 16		56,975 62
Leelanau.....	3,078,993 00	7,034 93	11,379 52		18,414 45
Lenawee.....	40,651,635 00	28,012 98	46,696 79		74,709 77
Livingston.....	15,681,870 00	20,250 05	22,524 52		42,774 57
Luce.....	3,532,535 00	5,608 83	7,752 19	4,000 82	17,381 83
Mackinac.....	3,392,139 00	10,407 08	13,530 78		23,937 86
Macomb.....	27,350,545 00	20,579 44	37,462 33		58,041 77
Manistee.....	10,258,188 00	9,591 70	21,660 20	20,623 18	51,875 08
Marquette.....	53,175,740 00	17,292 01	24,426 45	41,999 61	83,718 07
Mason.....	7,258,475 00	11,211 03	16,029 20	10,517 25	37,757 48
Mecosta.....	5,286,405 00	13,798 98	20,887 42	10,341 39	45,007 79
Menominee.....	10,511,389 00	17,988 14	20,541 04	20,790 30	59,310 08

FOURTH BIENNIAL REPORT.

ASSESSED VALUATION AND HIGHWAY TAXES BY COUNTIES, 1911.—*Concluded.*

Townships.	Assessed valuation	Road Repair tax.	Highway Improvement tax.	County road tax.	Total highway taxes.
Midland.....	\$6,930,763 00	\$8,869 91	\$20,357 81		\$29,272 72
Missaukee.....	2,072,449 00	8,878 73	12,554 58	\$5,511 73	26,945 04
Monroe.....	20,684,025 00	16,461 08	33,161 25		49,622 33
Montcalm.....	11,628,574 00	23,626 24	30,709 15		54,335 39
Montmorency.....	997,285 00	5,368 91	3,814 26		9,183 17
Muskegon.....	19,757,958 00	12,908 64	18,080 62	45,347 00	76,336 26
Newaygo.....	6,261,455 00	18,255 36	44,957 09		63,212 45
Oakland.....	43,334,765 00	34,374 49	39,070 68		73,445 17
Oceana.....	6,723,397 00	14,127 55	26,631 37		40,758 92
Ogemaw.....	2,438,148 00	8,335 85	9,656 42		15,992 27
Ontonagon.....	5,845,196 00	23,354 24	35,837 41	15,785 43	74,977 08
Oscoda.....	5,683,980 00	12,304 95	23,854 28		36,159 23
Oscoda.....	940,025 00	2,480 34	3,180 34	784 44	6,445 12
Otsego.....	2,913,061 00	7,478 15	13,307 67		20,785 82
Ottawa.....	25,574,781 00	32,346 27	49,948 62	12,752 45	95,047 34
Presque Isle.....	3,035,876 00	7,674 93	10,256 86		17,931 79
Roscommon.....	1,622,227 00	3,998 45	7,174 29		11,172 74
Saginaw.....	43,459,769 00	29,628 13	44,701 55	77,845 04	143,174 72
Sanilac.....	14,561,847 00	30,975 73	42,206 31		73,192 04
Schoolcraft.....	2,923,562 00	5,764 42	8,846 63	8,499 54	23,113 59
Shiawassee.....	21,831,261 00	23,082 24	24,637 18		47,719 42
St. Clair.....	31,132,367 00	31,861 57	36,278 48		68,140 05
St. Joseph.....	18,140,046 00	12,434 23	18,171 48		30,505 71
Tuscola.....	15,149,400 00	24,811 00	50,487 68		75,298 68
Van Buren.....	16,468,194 00	29,493 16	42,813 96		72,307 12
Washtenaw.....	40,598,592 00	31,719 15	21,606 84		53,328 99
Wayne.....	467,400,635 00	37,944 30	62,927 68	29,977 99	130,849 98
Wexford.....	7,513,210 00	13,220 55	18,928 76	4,604 40	36,753 71
Totals.....	\$1,898,057,358 00	\$1,490,146 34	\$1,958,163 03	\$815,227 24	\$4,263,536 61

APPENDIX



BULLETIN NO. 4.

MACADAM ROADS

BY

FRANK F. ROGERS, C. E.,
DEPUTY STATE HIGHWAY COMMISSIONER.

MARCH, 1912.

TOWNSEND A. ELY,
STATE HIGHWAY COMMISSIONER.



MACADAM ROAD BUILDING.

It has been said that no invention, except that of the steam engine, has contributed so much to the science of locomotion as the system of road making founded on the discovery by Macadam that angular fragments on hard rock sufficiently reduced in size, will, under the pressure of wheels, coalesce or bind together and form a water-proof compacted mass of stone with a hard surface.

One hundred years ago John Loudon Macadam addressed a memorial to the English House of Commons setting forth his views of the best method of improving England's highways. This report made him Surveyor General of the Bristol district, where, about five years later, he began the construction of a system of roads that ever since has borne his name. It is the construction of these roads in the most approved manner and in such modernized forms as improved machinery has made possible that the writer will endeavor to discuss.

SURVEY AND PLAN.

The first requisite in the building or improving of any road is a well defined plan, either in the mind of the builder or, what is better, on paper in such intelligible form that any person who is competent to direct such work can understand it and lay out and build the road in accordance therewith. It is only when a well designed plan is followed that the best and most economical results in road building are attained.

The surveyor should determine and the plan should show the exact location of the road on the ground. To do so reference must be made to section lines and corners, or to some regular subdivision line and corner, so that any other engineer or surveyor can accurately locate the same, either on the ground or on a township plat. This means that each end of the road must be definitely located from a determinable point in some section, and the courses and distances between these points accurately measured and marked on the plans.

It is always best to make one hundred foot stations, noting all important objects, such as bridges, culverts, cross roads, etc., by stations with such plus readings as may be necessary. Stakes should be set along the sides, one row on each side parallel to the center line, and preferably twenty or twenty-five feet therefrom, so as to place them on the outer margins of the ditches or gutters where they will not be destroyed by ordinary traffic, nor so easily by grading teams. (See upper section Figure 1.)

Levels should be taken at each station as follows: (a) on the center line; (b) on the hub at each side stake; (c) on the bottom of each ditch, if there are side ditches. Plus levels should be taken on railroad

tracks, on the floors of culverts and bridges, in the beds of streams that serve as the outlets for road ditches, going far enough down stream to make sure that such outlet is adequate, and at such other points as the surveyor or engineer may deem necessary.

The plan and profile should be placed on the same sheet, projecting the plan vertically above or below the profile. Angles in the line may be indicated by broken lines, small circles or other symbols giving bearings, or angles and distances in figures, without attempting to lay out the courses with a protractor. The complete working profile should show by lines drawn to scale, as well as by figures: (a) the center cuts and fills; (b) the depth of each ditch or gutter from the hub stake adjacent thereto; (c) the vertical distance, up or down, from each side stake to the established center grade. Nothing less complete is satisfactory, for in most cases the work of grading will be placed in charge of a highway commissioner or his foreman without the assistance of an engineer. It is enough to show the elevation of grade line at change points with the percent of grade, plus or minus, between such points. One hundred feet to the inch horizontal and five or ten feet to the inch vertical are desirable scales, using standard cross-section paper having ten lines to the inch. Tracing cloth or paper is preferable for this work, so that blue prints can readily be made for the extra copies, which are always required for filing and for working plans on the road. This method makes sure that all copies are exact duplicates of the original.

GRADES.

On Michigan state reward roads the law requires that the steepest incline shall not exceed six percent, meaning a rise of six feet in each one hundred feet of length. It is desirable to keep the grades on macadam roads below that—even down to 3 percent or less—where the cost of grading is not burdensome.

Long stretches of unbroken grade are objectionable however, being more expensive to maintain than roads that are slightly undulating. Surveyors who insist on establishing such grades do their clients a two-fold injury—they unnecessarily increase both the first cost and the cost of maintenance. Grades that more nearly follow the lay of the land with vertical curves at change points make lines that appear more graceful and that seldom mar the landscape. When such grades are not steep enough to limit the size of loads, or cause excessive washing on the surface of the roadway, no valid objection to them can be raised.

To haul a load on a good level macadam road surface requires a tractive force equal to about $1/40$ of the weight of the load. To this must be added 20 lbs. per ton for each added percent of incline. Thus, it requires more than double the power used on the level to haul a given load up a 3 percent grade and about $3\frac{1}{2}$ times as much power to haul the same load up the 6 percent grade.

It is estimated that horses can exert one-tenth of their weight as a tractive force on continuous work and remain in good condition. But they can readily exert themselves for brief periods of time up to two, three, and even four times their daily average working capacity. With this in view, making proper allowance for the fatigue of the team due to raising its own weight up the incline, it will be seen that short

stretches of undulating grades, none of which exceed six percent, can not materially lessen the capacity of a macadam road.

GRADING.

The cost of grading depends upon the kind and amount of earth that must be handled and the distance it has to be moved. Where old roads have been regraded for the purpose of building state reward roads, the cost has usually run from \$200 to \$500 a mile, \$350 being a fair average. Some hilly roads have been graded at costs greater than \$2,000 a mile.

TOOLS REQUIRED.

For rather low turnpikes, no tool is so efficient as the road grader in skillful hands, although the plow and harrow are frequently required to put the road in shape for using the grader to advantage. On turnpikes with deep ditches, the flat, or Doan scraper, is an excellent tool. It is not intended to move earth far but will spread it evenly over the grade when rightly handled. The drag scraper is good for hauls up to 150 feet. Between that distance and 700 feet, wheel scrapers are best, but to use them economically there should be enough scrapers working, unless moving soft sand, to keep a snatch team busy; and, where the soil has to be loosened, another team on a plow. For hauls longer than 700 feet it is cheaper to use wagons.

DRAINAGE.

In most soils sufficient drainage is provided by building the ordinary turnpike with side ditches or gutters just large enough to provide for the free flow of such water as naturally comes to the road. In no case should deep unsightly ditches be cut along the roadside for the purpose of making fills. (See lower cut showing fill in Fig. No. 1.) In clay soils the bottoms of the ditches should be not less than two feet below the crown of the road, unless supplemented by tile drains. Especial pains must be taken to provide all road ditches with free outlets having sufficient fall to remove all water to some distance from the road.

Tile drains are needed in all springy or water bearing soils. Four-inch land tile laid along the upper side of the road, either under the gutter or in the shoulder, to cut off the flow of water before it reaches the road bed will usually prove sufficient. An additional line of tile can be placed on the other side later if found to be necessary. If springs have their sources in the road bed itself, it will be necessary to lay diagonal branches of tile directly to them. It is usually advisable to cover the tiles to a depth of six inches or more with gravel, cinders, broken stone or other porous material; and, in very wet soils, the drainage will be facilitated by filling the entire trench with some such material. Wrapping the joints with tar-paper has not proven satisfactory to the writer. If anything is required, strips of muslin or burlap are preferable. Quicksand can be kept out of tiles by excavating enough below grade so that the tiles can be laid in a bed of gravel, which should completely surround them to a thickness of from six to eight inches. The gravel used should have the voids practically filled with smaller pebbles grading down to coarse sand.

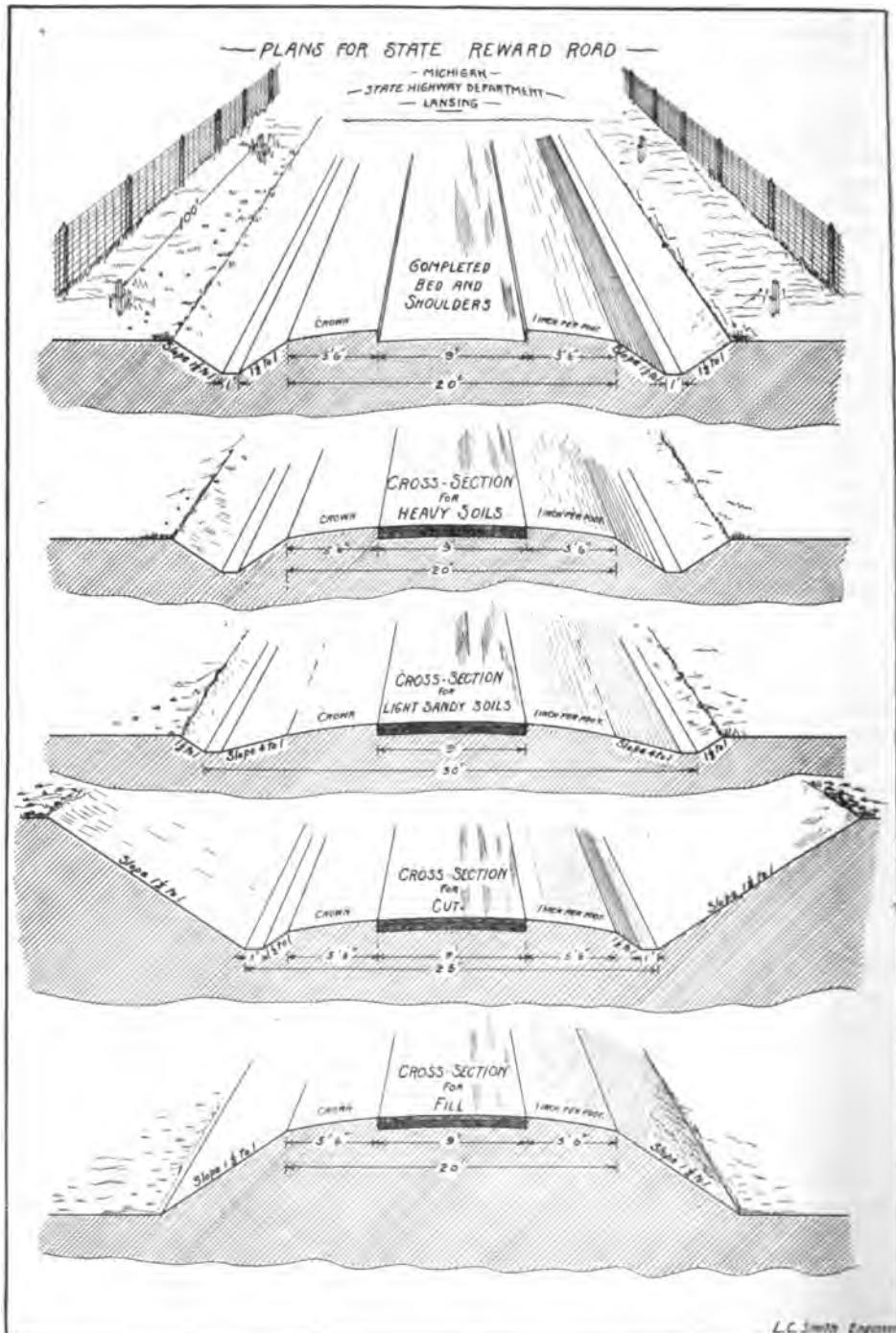


Fig. No 1.

In clay soils trenches should be cut through the shoulders described in the next paragraph, thus making outlets into the side ditches for water that may collect in the stone bed during construction, and afterwards until the surface becomes hard and water-proof. Such trenches should be 8 inches or 10 inches in width and slightly deeper than the stone bed. Where the foundation is soft or yielding, it is best to prepare the bed deep enough for an extra or sub-layer of some hard porous material, which is an excellent substitute for the old fashioned Telford base. This bed should be V-shape in section and filled with crushed stone, coarse gravel or small cobbles. The sub-base should be well rolled and properly shaped before the bottom layer of macadam is applied. In such cases the lateral trenches should be cut deep enough to draw the water from this sub-layer. (See Fig. No. 2.) These drains should be placed on both sides, in pairs, at every low point in the grade and, in very retentive soils, at intervals of not more than 100 feet.

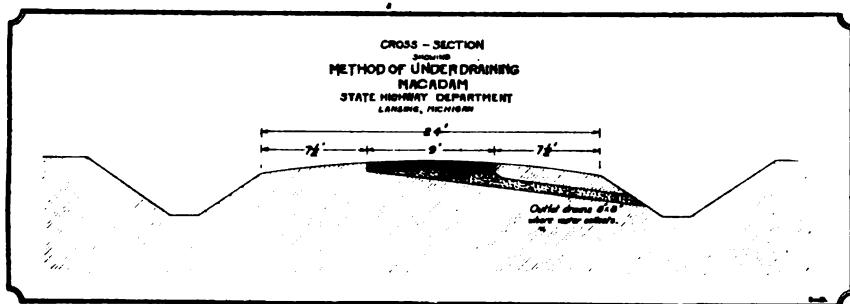


Fig. No. 2.

On grades above 4% there is frequently much trouble caused by the washing or gullying out of the side gutters. This can be effectively prevented by paving the gutters with cobblestones or concrete. A cheaper method, which most always proves satisfactory, is to spread evenly over the bottoms of the gutters a three or four-inch layer of crushed stone, preferably that under 1½ inches in size. Coarse gravel has been used for this purpose with good results.

MACADAM BED AND SHOULDERERS.

After the rough grading and draining just described have been completed, except the lateral stone drains above noted, the macadam bed should be formed in the central part of the road grade. This is done by placing shoulders of firm earth, or other suitable material, on each side of the center line and far enough apart to retain the proposed width of macadam, which, on Michigan state reward roads, must be at least 9 feet wide and not less than 6 inches deep after compacting. Any greater width and depth that the builders desire to make would be approved by the state but would not, under present laws, entitle the road to any greater bounty.

When the old road grade is as high or higher than the finished road should be, the shoulders are best formed by scraping earth from the

center to each side with a road grader. But first, the road should be leveled by driving the grader back and forth on the center of the turnpike with the blade set square across, so as to cut off the high places and deposit the earth in the hollows—using the grader as a planing tool. A double row of pickets set along the margins of the macadam bed, but one foot farther out so as to clear the hubs and whiffletrees, is a convenient method of marking out the grader work.

If the old grade is much too low, it is usually cheaper to regrade and turnpike before beginning to form the shoulders. But, where the old bed is about the right height for sub-grade, shoulders may be formed by bringing up earth from the sides with the grader, provided it can be spared from the gutters or ditches. In no case should the side ditches be cut deeper than good drainage requires. A common mistake is to excavate unnecessarily large and unsightly ditches along the roadside at the foot of a fill, for the purpose of forming the embankment. This is entirely unnecessary if the cuts and fills are properly balanced and should never be tolerated in highway work.

If enough earth cannot be spared from the sides adjacent to make the shoulders, it should be hauled with scrapers or wagons from other places where there is an excess, or taken from borrow-pits. Many places will be found where the center can be notched out, leaving the undisturbed sides for shoulders, and using the earth thus obtained to build up shoulders on slightly lower ground.

On sandy or mucky ground, it is often desirable to seek a better shoulder material. In such cases, any of the clayey or loamy soils are suitable, but a good packing gravel is better and should be used if practicable. A double layer of sods about one foot in width, placed grass side down along each margin of the stone bed, carefully laid to lines, and backed up with sand or other light soil, makes a very satisfactory shoulder. The writer has seen miles of macadam built over sandy soils with the sod-margin shoulder above described and knows of but few cases where there is any complaint from the spreading of the stone or from the shearing off of the edges of the macadam.

The shoulders thus formed should extend to the side ditches or gutters with the same grade and curvature as required for the finished road, viz.: an average rise of one inch for each foot of distance from the inner edge of the ditches or gutters to the center line of the road. Thus, a twenty foot roadway would have a 10-inch crown and a 24-foot roadway a 12-inch crown. With this kind of road section, the drop at a point 5 feet out from the center line should not exceed 3 inches.

After the work above described has been completed, lines should be set up on the margins of the macadam bed and enough hand trimming done with mattocks and shovels to bring the macadam bed to the exact sub-grade, giving it the same width and curvature as required for the finished road. Due allowance must be made for settlement of the sub-grade by rolling. Crushed stone is far too expensive a material to fill hollows with, for they can be filled with earth from the shoulders at less than $1/10$ the cost of broken stone, and every high point protruding into the macadam means a defective place in the finished road and hastens the day when repairs will be necessary. (See Figures Nos. 3 and 4.)



Figure No. 3.



Figure No. 4.



SUITABLE ROCKS FOR MACADAM.

A good stone for road building must be hard and tough, and the dust resulting from crushing and the wear of traffic, should have reasonably good cementing qualities.

In Michigan the most used road stones, in the order of their values, are: trap, cobblestones or field boulders, and limestone. The former is found only in the Upper Peninsula, and, thus far, has not been used on country roads except in the counties of Dickinson, Gogebic, Houghton, Keweenaw and Marquette, although some has been shipped to Detroit for park roads. There is no doubt that trap rock from Upper Michigan would be extensively used in the Southern Peninsula for the surface layer of macadam roads, if it were commercially available on a large scale, and at reasonable cost. Large outcrops of this rock are within one-half mile of Marquette prison and there is no good reason why this rock should not be crushed with prison labor and shipped to all our lake ports at a comparatively small price per ton. A large part of the limestone macadam used on the west side of the state is shipped across Lake Michigan from Wisconsin, and rock could almost as easily be shipped from Marquette if proper arrangements were made to supply the stone and transport it economically.

Cobblestones consist of a variety of rocks which range from the toughest traps down through the various grades of granites and limestones to a few sandstones, which are of no value to the roadbuilder. They are not uniformly distributed over the state, some sections having an abundance, while in other sections they are entirely wanting. Crushed cobblestones are not available on a commercial scale and are usually crushed with portable machines placed near where they are to be used.

CRUSHING COBBLES.

There is no difficulty in crushing cobblestones with portable crushers, where the best types of steel crushers are employed. Cast iron crushers and ordinary cast iron die plates are of little use for this work. For the most part, crushers having cast steel frames and equipped with manganese steel jaw plates have given the best satisfaction. In a few cases, some special makes of plates have given fairly good results. Traction engines rated at from 15 to 20 H. P. will easily drive any of these crushers. It is not economy to use a steam roller for this purpose. It is needed for rolling every day the crusher is running, and is too expensive a machine to wear out for power purposes.

The most satisfactory way to purchase cobblestones is by weight. From 13,500 pounds to 14,000 pounds are required for a cord, the weight being stipulated by the purchaser when the order is placed. Contractors figure that a cord of cobblestones will make 5 cubic yards of crushed rock measured in the different grades.

The labor cost of crushing cobblestone, including fuel and oil and small repairs, can usually be kept down to 30 cents per cubic yard under good management. If one figures repairs and depreciation, interest on the investment, etc., it would add approximately another 20 cents per cubic yard to the cost of crushing.

To prepare suitable sizes of broken stone it is necessary that the portable crusher be equipped with a rotary screen, the drum of which shall

be not less than 9 feet long and 30 inches in diameter, consisting of three sections perforated to give the required sizes of metal. When crushing cobbles, the writer usually prefers to have these sections perforated with $\frac{3}{4}$ -inch, 2-inch and 3-inch holes. Pieces of rock that are too large to pass through the 3-inch section, should be returned to the crusher and recrushed. Frequently a return belt conveyor is attached to the elevator, which does this work automatically. If the stone is so soft that too large a percentage of screenings passes through the $\frac{3}{4}$ -inch holes, a $\frac{1}{2}$ -inch mesh wire screen should be placed around the plate screen and bolted to it, forming a jacket. To do this, 3-inch wooden blocks or pieces of small-sized gas pipe, three inches long, are placed between the plate and wire screens through which the bolts are passed. This leaves an annular space between the two screens, which are so adjusted that the small stones passing through the plate screen and over the wire screen are discharged into the second pocket of the storage bin together with the 2-inch stone. On the other hand, if too much dust is produced as might be the case with limestone, a $\frac{1}{4}$ -inch mesh wire screen attached as above described, may be used as a dust jacket and the dust spouted into a special pocket from which it can be hauled away and wasted. This might result in a scarcity of binder, as only that part of the product passing through the $\frac{3}{4}$ -inch screen and retained on the $\frac{1}{4}$ -inch screen could be used. In such a case it would be necessary to have the first section of the screen perforated with 1-inch holes, instead of $\frac{3}{4}$ -inch holes.

From the above it will be noted that three grades of stone are provided which are discharged into separate pockets of the storage bins. From these they are drawn by gravity directly into the wagons in the order they are to be placed on the road. The fine stone is commonly called "screenings" or "binder," but for convenience the different grades are usually designated by the numbers 1, 2 and 3—number 3 being the largest size. (See Figures Nos. 5 and 7.)

Limestone, which is used for building most of the macadam roads in Michigan, is usually bought from the large commercial crushing plants, broken to such sizes as the work requires and delivered by boat or rail at points within teaming distance of the proposed road.

FIRST COURSE OF MACADAM.

After the macadam bed and shoulders, with sub-base and special drains where needed, have been prepared as already described and well compacted by rolling, the first course of No. 3 stone is laid. This must cover the bed to such uniform thickness as will make the depth not less than $3\frac{1}{2}$ inches after rolling, say $4\frac{1}{2}$ inches loose measure. If a harder and more expensive stone is to be used for the surface, the bottom layer may be increased to 5 inches loose measure and the top layer thinned accordingly.

Pains must be taken in placing the stone on the road to make sure that the different sizes are well mixed. Alternate patches of large and small-sized stones will not make a road surface that wears evenly. Unless automatic spreading wagons are used, it is best to make three or four dumps of each load, so that the least possible amount of handling with rakes and shovels will be required. In no case should this layer

be put on a muddy bed. After the stone has been spread as above described, it should be rolled two or three times over with a power roller weighing about 10 tons and then covered with No. 1 stone (screenings) to a uniform depth of about $\frac{3}{4}$ -inch and rerolled. The rolling should commence on the edge of the stone with about half of the outer rear wheel of the roller lapping on the earth shoulder, and gradually lapping towards the center as the rolling continues. As soon as one-half of the roadway is thus rolled the roller should be run off the stone and started on the other side which should be rolled in the same manner finishing at the center. Any other method will soon destroy the crown of the road. (See Figure No. 3.)

The amount of screenings used should be somewhat less than enough to fill the voids in the No. 3 stone. Water may be applied in advance of the roller when working on sandy soils but not until the roller has passed a few times over the dry screenings. But water should be used sparingly, if at all, on the No. 3 stone when building over clay and loamy soils on account of the tendency to form mud on the sub-grade, into which the stone are driven by the roller. Water is beneficial, however, and is usually a necessity on sandy soils to prevent the sand from mixing with the stone. The rolling of this course must continue until the binder is all worked into the crevices of the larger stones and until the stones cease to sink or creep beneath the roller. If hollows develop by reason of this rolling, they should be filled with suitable stones of the same grade and not with screenings.

If commercial limestone is used, it is better to use stone that will range from $1\frac{1}{2}$ to 3 inches in their greatest dimensions, and to use the same grade of stone for both the bottom and top layers, but it is very important that the stone shall be evenly mixed when spread upon the road. When limestone screenings are used for binder, only those from which the dust has been removed should be accepted. Plenty of dust for cementing purposes will be formed under the roller, and, when the road is once consolidated, the less dust on the surface the better. This dust is a nuisance in dry weather and makes a disagreeable mud when the weather is wet.

SAND SUB-GRADES.

Before placing the first layer of stone on dry, mealy sand sub-grades, it is often necessary to spread a thin layer of marsh hay, wet straw or some other vegetable fibre over the entire stone bed to prevent a large part of the No. 3 stone from being driven into the sand so deeply that it is of little value except as a sub-base. An extra layer of stone rolled into the sub-grade makes a foundation equally as good or better than the materials above mentioned, but the cost of the stone usually makes this latter method so expensive that it is prohibitive.

TOP COURSE OF MACADAM.

After the first course of macadam has been applied and bonded and rolled as above described another layer of stone must be added and of such uniform thickness as to make the total compacted depth of the road at least 6 inches, if it is expected to draw state reward. If the first layer was $4\frac{1}{2}$ inches loose depth the top layer must be at least

3½ inches deep, or, if the first layer was made 5 inches thick the top layer may be reduced to 3 inches. The stone used in this layer will be that known as No. 2, which passed through the 2-inch perforations of the crusher screen and was caught in the second pocket of the elevator bins. However, should limestone from the commercial quarries be used, it is better to purchase stones ranging from 1½ to 3 inches in size, as already specified for the first course of macadam. Stones of this size wear much better, are not easily dislodged and left in a loose condition on the road bed, nor so easily picked up by the mud that adheres to the wheels of vehicles. Some engineers have placed the No. 2 limestone in the bottom layer and the No. 3 limestone in the top layer, and the results are reported to be very satisfactory. But this is not necessary unless the whole product of the crusher must be used, which is not true when crushed stone is bought from the large quarries. What was said about the manner of spreading stone for the bottom layer applies with equal force to the top layer.

When the stone for the top layer has been spread as above described, it shall be rolled until smooth with a 10-ton power roller, after which screenings (No. 1 stone) will again be applied to the uniform depth of about ¾ of an inch and rolled a few times over before wetting. From this on, water must be applied freely from a horse sprinkler and the rolling continued until the water flushes to the surface. As the rolling progresses, the screenings will disappear in patches, when more screenings will have to be added until all the voids are filled and a very thin coating of screenings covers the surface.

In no case should the screenings be dumped in piles on the loose stones. When this is done, the screenings are never evenly spread and many of them are wasted. Too many screenings are detrimental to the road as well as a total waste of the most expensive part of the road covering, particularly if made from hard stone. Unless the screenings can be spread evenly with automatic spreading wagons, it is best to place them on the shoulders along the sides of the roadway and spread them carefully by hand. Pains must be taken to apply the screenings evenly mixed. Casting crosswise of the road with shovels invariably places the chips on the far side and the dust on the side where the spreader stands. This can be overcome by casting lengthwise of the road with a swinging motion of the shovel.

The manner of rolling described for the bottom layer applies equally to the top layer. In the final rolling, however, the whole surface of the roadway, including the shoulders, must be covered. Hollows that may have developed in the shoulders must be filled, and high places leveled down and the process of leveling and rolling continued until the whole road grade from gutter to gutter is so firm and smooth that water will flow to the side drains without obstruction. Figure No. 4 shows both layers of stone and a steam roller at work.

After the thorough watering and rolling above described has been completed, the road should be kept closed to traffic until the surplus water has dried out, when the road, if well constructed, will have taken a "set" and become so hard that it will have a metallic ring when driving over it and small pieces of rock will crush under a heavy load before penetrating the surface.

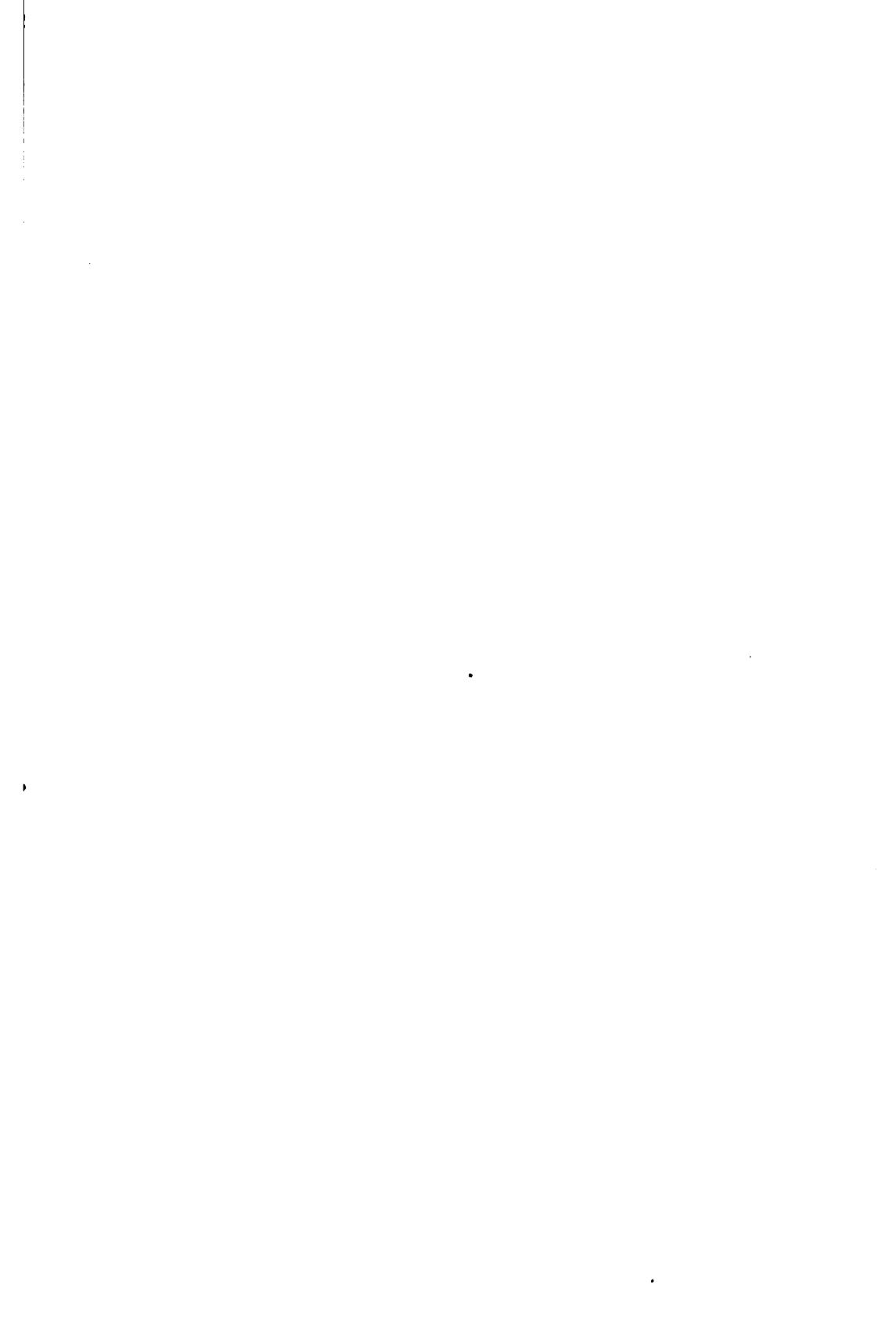
The amount of rolling and water required are much more than the



Figure No. 5.



Figure No. 6.



inexperienced road builder will expect. Gillette estimates that about 4 cubic feet of water are required for each cubic yard of compacted macadam to properly "puddle" the screenings or binder. That is equivalent to about 900 barrels of water for each mile of 9-foot macadam roadway, which is no small item of cost if the water is not very handy. If the water is not used to the best advantage more will be required.

A steam roller cannot compact more than 50 to 75 cubic yards of crushed rock daily. That is about the output of the ordinary portable rock crusher and means that from 20 to 30 days of steady rolling are required to properly consolidate a mile of state reward macadam road. For completed macadam road see Fig. No. 6.

COST OF MACADAM ROADS.

The average cost of macadam roads in Michigan is running slightly less than \$4,500 a mile. Some roads have been built for less than \$3,000, while others have cost more than \$8,000 per mile. The higher costs usually mean that the grading cost was high, or that the width of macadam was made greater than 9 feet.

Every road is a problem by itself, depending on so many local conditions that averages are of little satisfaction to a person desiring to know the actual probable cost of a given road. As the grading cost, the material cost and the distance the material has to be hauled are the three items subject to greatest variation, a model estimate will be given on which the above items will be taken at fair assumed values, so that they can be changed by anyone desiring to make other estimates that will fit different conditions and places where these values have been determined.

First, we shall assume that crushed limestone is to be purchased from a commercial quarry and delivered f. o. b. cars at some siding within a wagon haul of the proposed road. The estimates are as follows:

Grading, per mile	\$350 00
1,200 cu. yds. crushed stone 1½ to 2 in. in size at \$1.40..	1,680 00
300 cu. yds. screenings with dust out at \$1.40.....	420 00
Loading and hauling 1,500 cu. yds. stone one mile at \$.45..	675 00
Spreading same \$.05	75 00
Sprinkling and rolling, 25 days at \$15.00.....	375 00
Superintendence and contingencies	200 00
 Total	 \$3,775 00

If crushed cobblestones are used, 300 cords to the mile will be required. These should crush into 1,500 cubic yards, measured in the different grades. The crusher should be set but once for each mile of road and as near the center of the mile as is practicable. In this case, the stone cost at \$4.00 per cord would be as follows:

300 cords cobbles at \$4.00.....	\$1,200 00
Crushing 1,500 cu. yds. at \$.50	750 00
Hauling 1,500 cu. yds. of stone to the road (no shoveling into wagons required) at 30c.....	450 00
 Total	 \$2,400 00

This shows a saving on stone delivered to the road of \$375.00 and we may assume that the other items will remain the same. In such a case, one would be justified in paying \$5.25 per cord for cobbles delivered at the crusher, as compared with commercial stone at \$1.40 per cubic yard on cars one mile from the road.

The following cost is taken from the Michigan state reward road built in Golden township, Oceana county, by Fred Urtel, Township Highway Commissioner.

Grading	\$237 40
301½ cords cobbles at \$4.00	1,206 00
Crushing same	547 87
Hauling stone from the crusher and spreading on the road..	500 20
Rolling and sprinkling	208 12
Superintendence and plans	162 12
 Total	 \$2,861 71

The above cost is very low and does not include profits to any one, nor rental or depreciation for the machinery used, as it is all owned by the township and the work was performed by day labor under the direction of the township commissioner. It does include, however, the cost of moving the crusher from a former location and erecting it on the job, as well as fuel and oil and other incidental expenses. It might be further said that the finished road was a credit to its builders.

Figure No. 5, shows the crusher at work on the above road, and Figure No. 7, further illustrates the methods employed in crushing cobblestones. The former shows a home-made bin and the latter a portable bin on trucks. Note what is said about using the roller for power purposes on page 141.

BITUMINOUS BONDED MACADAM.

The advent of the automobile has brought a new and destructive agent to the ordinary water-bound macadam highway. Rapidly driven motor cars propelled by the friction of pneumatic tires on the road surface have added two new and destructive forces that heretofore have not had to be taken into account by the road-builder. The suction of the tires added to the shearing action on the surface by the drivers destroys the ordinary macadam in a short time. In fact, macadam roads that had resisted the ordinary horse-drawn-vehicle traffic, with but little wear for many years, have gone to pieces rapidly under the automobile.

To overcome this trouble many localities are now resorting to a bituminous bonded surface, and, in most instances, where the most approved methods are used, with fairly good results.

The term bituminous is used interchangeably as referring both to asphalt and tar products. Generally speaking, present approved practice has settled down to three methods of using these materials.

(1) As a surface treatment for old or newly laid water bonded macadam on which a surfacing is needed, both as a dust layer and a surface coating which holds down the binder and bonds the surface



Figure No. 7.

stones sufficiently to prevent them from getting loose under the shearing and suction action of the rubber tires of rapidly driven motor cars.

(2) As a binder by the penetration process for the top layer of No. 2 stone before the screenings are applied.

(3) As a binder by the mixing process for the top layer of No. 2 stone.

SURFACE TREATMENT.

Where the surface treatment is used on old roads, they should first be thoroughly cleaned by removing all dirt, dust or other foreign material. All hollows should be filled with No. 2 stone or rather coarse chips which have previously been coated with the bituminous mixture. The day before the bitumen is applied, the road should be thoroughly sprinkled. It is well to sprinkle in the afternoon and apply the bitumen the next morning, after the water has been absorbed by the road surface, but before the surface has dried. Chas Ross, Superintendent of Streets, of Newton, Massachusetts, who has had much experience with bituminous materials, says that the wetting will cause the oil or tar to adhere, when, if it were spread on the layer of dust, no matter how thin, it will separate and roll up on the wheels of vehicles.

The bitumen may be applied by hand with sprinkling cans having fan shaped nozzles, with horse sprinklers having distributing devices adapted to the purpose, or what is still better, with pressure distributors that apply the bitumen as a fine spray. One-half gallon to the square yard is usually sufficient for a surface application on hardened road surfaces. It is generally admitted that two applications of $\frac{1}{4}$ gallon each are better than to put on the full amount at a single application. This cannot be done unless a pressure distributor is used.

A few hours after the bitumen has been applied, the entire road surface should be covered with stone screenings or pea gravel to a depth of about $\frac{1}{4}$ -inch, or in sufficient quantities to absorb any surplus oil or tar. The next day, the road can be safely opened to traffic.

If a new macadam road is to be thus treated, it should first be thoroughly consolidated by watering and rolling, as specified for the ordinary water-bound macadam, then allowed to dry out, when it can be treated as above described. Many engineers prefer that such a road should be traveled several months, or even a year, before the bituminous surface is applied.

The lighter oils, meaning those that can be applied without heating, are used more for dust layers than binders, but much that has been specified above will apply equally well to the manner of using these oils.

PENETRATION METHOD.

When the penetration method is used, the layer of No. 2 stone should be put on a base in which the voids are completely filled so as to prevent the loss of bitumen by seepage into the lower layers. This can be done by using more than the usual amount of screenings and thoroughly compacting the bottom layer, supplementing the screenings with fine gravel or coarse sand if necessary to make the desired bond and finish. More watering and rolling will be required than is commonly given the bottom layer.

After spreading on a bed thus well prepared, the No. 2 stone should be coated as thoroughly as possible by the means employed with a heavy bituminous binder applied hot, usually at temperatures ranging from 250 to 300 degrees F. The bitumen may be applied by any of the methods described for surface treatment, but the pressure distributor is always preferable.

Heavy asphaltic bitumen should contain about 90% of asphalt. If the refined tars are used, they should be of such purity and consistency as will give them equal binding powers to asphalt, but without brittleness which is always detrimental to a bituminous binder. From $\frac{3}{4}$ to one gallon per square yard is usually required for the first application, after which stone chips $\frac{3}{4}$ -inch in size (stone screenings from which the dust has been removed) should be evenly spread over the surface to the depth of about $\frac{1}{2}$ -inch and rolled in. After this rolling a second application of heated bitumen will be required, using from $\frac{1}{4}$ to $\frac{1}{2}$ gallon to the square yard, which should be thinly covered with pea size stone or fine gravel and lightly rolled, or allowed to work in under traffic. The road can be opened to travel the next day after finishing.

MIXING METHOD.

The mixing method is used more for city streets or suburban roads near large cities, where considerable money is available for road building purposes. This method is commonly conceded to be the best, but for the reasons above stated, it has not been so extensively used as the others.

The heavy bitumens, containing about 90% of asphalt, or correspondingly heavy tars, are required for this purpose. The stone to be coated is usually heated and mixed with the bitumen, either by hand after the "sweat board" plan of mixing concrete, or in suitable mechanical mixers. Concrete mixers, both of the continuous and batch type have been successfully used for this work, but the best results can be produced by using a regular asphalt batch-mixer of standard pattern.

The foundation for this bituminous concrete top may be ordinary water-bound macadam, old or new, or a regular concrete base similar to that used under brick pavements. The success of this form of pavement, like all others, is largely dependent on the stability of its base.

The bituminous macadam top should be at least 2 inches thick after thorough rolling, and thicker where the traffic is very heavy. At least 25% will have to be allowed for compacting. The crushed stone used for the top should all be fine enough to pass through a 2-inch mesh screen and should include all sizes down to screenings, from which the dust has been removed. This stone should be evenly mixed, the smaller sizes as completely filling the voids in the larger ones as possible. The more nearly the voids have been filled, the better will be the results. Coarse sand and fine gravels are sometimes added to fill the voids more completely than is possible with clear stone.

Crushed stone can be more evenly heated in some of the forms of rotary heaters now on the market. Several other forms are said to be successful. The writer has used ordinary scrap boiler iron, raised sufficiently from the ground by means of bricks or stones to allow placing a fire under the plates, on which the stone was piled and turned with hoes and long-handled shovels until sufficiently heated. After

heating, the stone may be wheeled or drawn to the mixer in wagons.

It is now said that the same results can be produced by washing the stone with crude gasoline, using about 12 quarts of gasoline to a ton of stone. This is accomplished by first charging a batch mixer with the stone, then throwing in the gasoline, which is evaporated after a few turns of the mixer, when the bitumen can be added and the mixing completed. Only enough bitumen should be used to thoroughly coat each fragment of stone. From 8 to 10 gallons of bitumen to the ton of stone should be sufficient. An excess of bitumen is always detrimental. When the bituminous-concrete top has been applied and rolled, it is necessary to again coat the surface with a thin covering of the same kind of liquid bitumen applied hot, at the rate of about $\frac{1}{4}$ gallon to the square yard, after which the pavement is covered to the depth of $\frac{1}{4}$ -inch with stone screenings, pea gravel or coarse sand and lightly rolled. When thoroughly set the road can be opened to travel. This is usually the next day after finishing.

The cost of roads, on which bituminous materials are used, generally exceeds the cost of ordinary water-bound macadam by from 12c to 50c per square yard of road surface treated, varying with the methods employed. Many miles of Michigan roads have been coated with light asphaltic oils, applied cold, at a cost of about 2c per square yard. A single treatment lays the dust and usually saves the road from disintegration for one season.



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